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IMPACT OF THE FEDERAL TAX CODE ON RESOURCE RECOVERY

by

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The study assessed the extent to which a variety of federal tax subsidies to extractive industries affect the flow of materials to competing secondary materials industries. The impacts on virgin material supply for steel, paper, lead, copper, and aluminum industries were analyzed and flows of virgin and secondary materials characterized at points where they substitute as inputs to production. Econometric models were used to analyze the impacts on quantities of secondary materials recycled. It was estimated that the short-run effect of eliminating federal tax subsidies would increase the recycling of scrap steel by 0.42 percent; waste paper, 0.67 percent; lead, 0.75 percent; copper, 0.35 percent; and aluminum, 1.7 percent. The cumulative effect over the long-run from the elimination of the subsidies may be considerably larger if the impacts on investment and choice of technology decisions in the affected industries are included.

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ABSTRACT

This report assesses the extent to which a variety of federal tax subsidies to extractive industries affect the materials flow in competing secondary industries. The impacts of tax subsidies on virgin material supply curves for the steel, paper, lead, copper, and aluminum industries are analyzed in detail. The flows of virgin and secondary materials industries are characterized at points where the two materials substitute as inputs to production and consumption. Econometric models specified at these points of substitution are used to analyze the impacts of the tax subsidies on the quantities of secondary materials -which are recycled. Within the limits of existing plant and equipment, we estimate that elimination of tax subsidies to virgin material industries would increase the flow of scrap steel by 0.42 percent, of wastepaper by 0.67 percent, of lead by 0.75 percent, of copper by 0.35 percent, and of aluminum by 1.7 percent. These estimates make no allowance for the long-run effects on investment which may arise from the subsidization of one of two competing industries. When investment effects and other federal policies (especially ICC regulation of freight rates, labeling requirements for scrap-based products, and the free access to minerals on federal lands) are also considered, the cumulative adverse impact on recycling may be far larger than the relatively modest effects measured in this report.

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CHAPTER 1

INTRODUCTION AND SUMMARY

Fears of future materials shortages and a concern for improving the quality of the environment have heightened public interest in recycling. Several major pieces of legislation contain statements to the effect that increased recycling should be a national goal. Despite efforts to define and establish a national materials policy, we have at present only a de facto policy which appears to favor use of virgin over secondary materials. Some aspects of this overall policy include:

(1) Taxation - as a consequence of depletion, expensing of exploration and development, capital gains, Domestic International Sales Corporation allowances, Western Hemisphere Trade Corporation allowances, and the foreign tax credit, investment in virgin material industries (either the purely extractive component, or in vertically integrated firms) is stimulated and product prices are lowered compared with results under neutral taxation.

(2) Freight Rates - railroad freight rates, which are controlled by the ICC, may be lower for virgin materials than for an equal volume of scrap.

(3) Labeling - several products derived from scrap materials are required to be so labeled. Rather than specify performance requirements alone, labels which are required to specify source discourage consumption by those who associate the words "recycled" or "waste" with inferior products.

(4) Others - federal procurement policies, at least in the past, have favored virgin materials over secondary sources. The mineral discovery system which gives away valuable

mineral rights to stimulate exploration for virgin mineral. supplies creates incentives favoring investments in virgin over scrap industries. Finally, the tax exempt status of municipal trash collection systems, combined with their financing out of general revenues rather than user charges, lowers the perceived cost of waste disposal and tends to stimulate greater waste production than would result if charges were based on use and reflected full social costs of disposal.

It has been alleged by many that national materials use is strongly biased toward the use of virgin raw materials over recycled or secodary materials and that a policy based upon a thorough analysis of social benefits and costs would favor more intensive use of recycled materials. Private incentives with respect to materials use may not reflect social desires for a variety of reasons. (1) Private profits are independent of social costs associated with the disposal of materials which are not recycled. (2) Environmental disruption associated with primary production is normally not a cost to primary producers. (3) The needs of future generations may receive too little attention if virgin material production is guided by current and projected prices rather than by an attempt to explicitly maximize intergenerational welfare.

This report is positive rather than normative or prescriptive. No attempt is made to determine or design the essential features of future federal materials policies. The intent of the report is to provide a comprehensive analysis of one element of the present de facto materials policy - the federal tax code - and its impact on virgin materials use and recycling in selected key industries including: paper, steel, copper, aluminum, and lead. Certain other policy elements, including federal mineral and timber policies, are also briefly reviewed.

Focusing as it does on one element of a complex national policy toward material use, the report must be accepted with caution. Though one element of the overall policy may not be of overwhelming import, taken

collectively the various factors may have a highly significant impact on materials use.

This report is organized into eleven additional chapters and an appendix which trace virgin material tax subsidies through their historical development, analyze their present impact on corporate profits and market prices for outputs, and estimate the impact of the tax subsidies on recycling rates.

In Chapter 2 a central theme is developed: few if any of the arguments offered to justify the subsidization of mineral and timber industries are grounded in fundamental, widely-accepted economic criteria such as equity or efficiency. Mining and timber industries are among many which are accorded subsidization in the federal tax code. The significant tax subsidies to mining and timber operations are described in detail, both as to historical development and present magnitudes. An appendix to this report further delineates these historical developments.

Chapter 3 depicts the present pattern of industry taxation from a micro, or individual corporation point of view. Drawing from detailed corporate financial statistics in SEC Form 10-K reports, the magnitude of the tax burden in several industries is examined. Subsidies to mining, timber and paper companies result in lower effective tax rates on income. Paper companies have an income tax rate approximately 10 percent below general manufacturing; and mining companies pay about 30 percent less: in taxes than a typical manufacturing firm would on identical income. This chapter also develops statistics on property tax rates for these industries.

The fourth chapter examines in detail a non-tax subsidy to mineral industries, the General Mining Law of 1872. Although the clear intent of the General Mining Law was to promote mineral exploration and development, inadequate provision for record keeping and inappropriate controls on excessive

claim filing have unintentionally erected barriers to mineral development. This Law was analyzed because revision appears imminent - and all of the proposals for change involve the imposition of new taxes on mining.

The fifth chapter analyzes some of the indirect impacts of taxation on timber supplies through a detailed examination of timber resource allocation. Theoretically, taxation affects timber supplies directly as timber becomes more profitable than alternative land uses and indirectly through adjustments in the profit maximizing growth periods. Because the production function for timber is not well known, it is difficult to estimate the impact of timber tax subsidies on the supply of timber. Therefore, the analysis carried out in this chapter is largely theoretical in nature.

Chapter 6 contains estimates of the impact of various income tax subsidies on the price of certain virgin materials. Though final conclusions of market impact are unaffected by whether a tax is viewed as shifting supply or demand, the analysis here is simplified by assuming all effects are achieved through movement of the supply curve. The analysis of this chapter is biased toward taking an optimistic view of recycling potentials in that where assumptions must be made they err toward overstating the impact of tax subsidies in lowering virgin material prices.

Where taxes affect the cost of one factor of production (e.g., capital gains which affect the cost of capital), it is explicitly assumed that the change in relative factor prices will induce no substitution among inputs. This assumption makes it appear that by removing a tax subsidy to virgin timber production the full increase in the cost of capital will be realized and passed on in the form of higher supply prices. No provision is made for the possibility of substitution of the now cheaper labor, which profit maximizing corporations would be expected to do. When assumptions about the elasticity of the supply curve must

be made, it is always assumed to be infinitely elastic, unless empirical estimates are available. Finally, in calculating the impact of the depletion allowance, corporate financial data were used where available, otherwise the maximum theoretically permitted by the tax code was used in place of the actual statistics.

Chapter 7 provides an overview of materials flows within the primary and secondary materials sectors with particular reference to points at which the two flows compete as inputs to production processes and as items of final consumption. We are especially interested in these points of substitution in calculating the impact of tax subsidization of one sector on materials flows within the other sector. The sources and uses of scrap materials are identified, setting the stage for econometric modeling of the materials flows of individual industries in the next five chapters.

In Chapters 8 through 12 we present analyses of the steel, paper, lead, copper, and aluminum industries. Using the discussion of materials flows as a framework for reference, we develop the background information for the econometric specification of intersectoral competition. The calculation of the impacts of tax subsidies to the virgin sector on the recycling of scrap materials could, in general, be performed in two ways.

In the first approach, which is admittedly short-run in nature, we used monthly data to estimate supply and demand curves for scrap materials, incorporating into the demand curve the price of both scrap and the competing virgin-based input. When the demand and supply curves are estimated with monthly data, we measure short-run responses to price changes holding the capital stock fixed. In the long-run, investment in new plant and equipment, which is influenced by relative input prices, would enhance considerably the possibilities for input substitution.

The second approach, which takes an optimistic long-run view, assumes that substitution between scrap and virgin inputs is perfect. In this model we need only the long-run supply curve for scrap materials to estimate the recycling impact. Where the data permitted, we estimated these supply curves with annual data in order to capture the effects of investment decisions on supply.

This research may be viewed as an extension of a 1974 study performed by Booz Allen and Hamilton, Inc. for the Environmental Protection Agency entitled, "An Evaluation of the Impact of Discriminatory Taxation on the Use of Primary and Secondary Raw Materials." That study outlined the various tax subsidies to virgin material production and derived maximum price impacts in much the same fashion that we did in Chapters 2 through 6. The use of econometric techniques in the present study to estimate the potential effect of these price impacts on recycling differs substantially from the interview methodology employed by previous researchers. In addition to statistical biases which would be present in any responses, the interview approach suffered because industry representatives were generally unwilling or unable to supply the requested estimates.

Chapter 13 contains a summary of the research results and a discussion of the strengths and weaknesses of the statistical approach which was used. This section also contains a brief outline of suggested extensions of the present study.

CHAPTER 2

TAX SUBSIDIES FOR MINERAL AND TIMBER INDUSTRIES

Over the years federal subsidization of various segments of the economy has become so familiar and ubiquitous that one is hard pressed to name a single unaffected activity. An almost endless list of federal subsidies include: the granting of free land to homesteaders (in the Western States in the 19th century, but in blighted urban areas now), the granting of mineral rights to individuals making valuable discoveries, sponsorship of research in social and physical sciences, and reductions in income tax liabilities for favored groups. The latter subsidy is especially significant; tax subsidies to industry are estimated to exceed $10 billion (see Table 2-1) and further deductions are given to homeowners, the elderly, the blind, families with children, and so forth.

A partial listing of estimated 1976 income tax subsidies for business firms is contained in Table 2-1. Of particular relevance to this report are the first four subsidies: expensing of mineral exploration and development costs - $950 million; excess of percentage over cost depletion - $2,200 million; capital gains treatment of iron ore and coal royalties - $5 million; and capital gains treatment of timber - $145 million. Since 1969, expensing has increased almost three fold and percentage depletion has increased by one half, but the other two categories show almost no change. Because the expensing and percent depletion figures contain deductions for the oil industry, it is desirable to separate that component attributable to non-fuel minerals. Expensing of exploration and development for non-fuel minerals has been assumed by the Treasury (perhaps incorrectly) to be negligible.

Table 2-1. ESTIMATED 1975 INCOME TAX SUBSIDIES
(Partial Listing)

	Millions of Dollars
Natural Resources, Environment and Energy:	
Expensing of exploration and development costs (oil and gas only)	950
Excess of percentage over cost depletion	2,200
Capital gain treatment of iron ore and coal royalties	5
Timber: capital gain treatment	145
Pollution control: 5-year amortization	30
International Affairs:	
Exclusion of dividends of LDC corporations	55
Domestic International Sales Corporations	1,070
Western Hemisphere Trade Corporations	50
Agriculture:	
Expensing of capital outlays	145
Capital gain treatment of certain income	20
Commerce and Transportation:	
Surtax exemption	3,590
Tax deferral for shipping companies	35
Railroad rolling stock amortization	60
Bad debt reserve for financial institutions in excess of actual losses	1,030
Business Investment:	
Depreciation on rental housing in excess of straight line	115
Depreciation on buildings in excess of straight line	280
Expensing of research and development	630
Capital gain (other than farming and timber)	595
Investment credit	4,160

Source: The Budget for Fiscal Year 1976, U.S.G.P.O., P.108-109

In this chapter the historical development of the taxation of mineral and timber industries is reviewed with an emphasis on the rationale or motivation for a favored status. A more comprehensive, supporting document to the views expressed in this section is contained in Appendix A. This appendix contains numerous verbatim quotes and analyses offered by those in Congress and in the mining industry at the time when the tax policy toward mineral industries was being promulgated. Following the historical review is an economic analysis of the arguments for and against subsidization of selected industries.

I. MINERAL TAXATION POLICY

A. History

The 1913 legislation for the first income tax contained provisions for the recovery of capital assets through depreciation deductions against taxable income. In recognition of the eventual exhaustion of producing mineral reserves, owners of such properties were permitted a deduction of five percent of the value of mineral production, the sum of deductions to be limited to total investment. A subsequent revenue act three years later introduced the term "depletion" and limited the total deduction to (1) the invested capital for those mines acquired after 1913, or (2) the 1913 value for mimes acquired prior to 1913. This limit on the total deduction was repealed in part in the Revenue Act of 1918 when the concept of "discovery depletion" was introduced. Under this system the depletion allowance for newly discovered minerals was based on fair market value to be determined within 30 days of discovery. Discovery depletion marked the first major departure from an asset recovery system limited to cost to one based on value. At that time it was argued that permitting the taxpayer a total depletion deduction equal to "discovery" value as opposed to a deduction based on acquisition cost, would stimulate mineral exploration by providing a tax break for newly discovered mines. The benefit would lie in exempting from future taxation an amount of ordinary income equal to the "discovery" value minus the acquisition cost.

Discovery depletion established tax equity between income from mines developed before 1913 for which depletion, based on 1913 value, often

exceeded actual cost, and income from mines developed after 1913 for which depletion had been limited to the investment. Although it may be argued that Congress should not permit a mine owner to deduct more than the total investment in the mine, it must be recognized that other costs associated with gaining ownership of the mine (primarily exploration activities to locate replacement mines) were only recovered gradually through addition to the adjusted basis. A provision to allow the value of the discovery to determine the amount of capital to be recovered would compensate for the delayed recovery of prospecting and developmental costs.

Aside from whether discovery depletion actually encouraged mineral exploration it developed two major problems. The first occurred when mineral prices dropped in 1921. Total allowable deductions were still based on the originally established discovery value and not 1921 market value. Concern that depletion deductions would be used to offset income from other sources, and mine owners would end up paying no taxes, prompted Congress to limit maximum deductions to the amount of net taxable income derived from the newly discovered mine. This provision, later amended to limit deductions to 50 percent of the net taxable income to ensure that all mine owners would pay some taxes, has remained in effect to the present time.

The second problem of discovery depletion involved the difficulty of estimating the extent of newly discovered minerals (especially oil and gas), defining a new well or mine, and assigning a reasonably fair market value to the property. Geological measuring procedures were unreliable, and there were no guidelines for determining fair market value. Inevitably, many new oil wells and mines were inaccurately valued by the Treasury. Not only was it extremely difficult to establish discovery values on the basis of incomplete information, but administration of the law was complicated by frequent litigation over the appropriateness of Treasury determined values. A Senate Select Committee was created in 1924 to investigate allegations of abuses under the law and to devise methods

of improving the capital recovery process. The Committee report suggested that future depletion be based on normal or average experience under the discovery depletion provision. Actual profits on a sample of mineral properties would be discounted back to establish a value as of the date of discovery. Depletion was to be computed as a percent of the value of mineral output which would result in recovery of the total value of the mineral discovery.

The Internal Revenue Act of 1926 permitted percent depletion of 27½ percent of the gross revenue from oil and gas because valuation problems under discovery depletion had been the most pronounced. Discovery depletion accounted for over 86 percent of the depletion deductions taken by the petroleum industry in the early 20's, giving rise to considerable confusion in the administration of the petroleum depletion allowance. In contrast, other mineral industries - especially those of the more commonly found minerals - made relatively little use of discovery depletion because most mines had been discovered before 1913. However, the mineral industries anticipated substantial after-tax savings if percentage depletion were available as an option.

Metal industry spokesmen argued that percentage depletion would simplify their depletion procedures, a necessary reform. Moreover, it was argued, their extraction processes were similar to petroleum, and equity required that similar industries be taxed in a similar manner. The mining industries requested a flat rate percentage depletion allowance which approximated the average depletion deductions taken in the past. Some argued that they needed a tax break in order to stimulate exploration and production, or to overcome the depressed state of their industry. It was also estimated that the switch to percentage depletion would result in no loss of tax revenue. In 1932 Congress began extending percentage depletion to the metal industries in spite of the Roosevelt Adminstration's objections that the depletion allowances permitted the taxpayer to recover far more than the full capital investment.

In the 1932 Act the owner of the mineral deposit was forced to make a binding decision between cost and percentage depletion. A failure to elect meant the loss of any rights to percent depletion. Although this restriction was eliminated in 1942, an owner today still must choose between cost and percent depletion. The list of minerals covered by percent depletion gradually expanded; many hardrock metallic minerals were added in the 1930's, several non-metallic minerals were included during World War II, and by 1954 Congress decided to include all minerals (including sea shells), except those from inexhaustible sources such as the air.

In 1969 percent depletion rates on all minerals were limited to a maximum of 22 percent; this entailed a reduction for oil and gas from the previous 27½ percent rate, and for many metallic minerals from a previous rate of 23 percent. In 1975 the percent depletion deduction for large oil and gas operators was eliminated. For smaller operators it was set at 22 percent until 1980, and scheduled to be gradually phased down.

Percent depletion represented an administrative improvement over discovery depletion; calculations were immensely simplified and subsequent litigation was essentially limited to determinations of who was entitled to depletion and at what stage in mineral processing was value to be determined. Basing the rates of percent depletion on historical data under the discovery depletion regulations, there was at least the intent that depletion would permit full recovery of the capital value of a mine.

At about the same time Congress was establishing capital recovery provisions for the mineral industries through cost and discovery depletion, other significant features for capital recovery were also being developed. In 1917 oil and gas operations were permitted to expense incidental drilling costs by deducting them against taxable income. In 1921 mine owners were granted similar expensing privileges for development expenditures.

Neither industry had the opportunity to expense outlays for mineral exploration.

In 1918 Congress attempted to prevent "double taxation" of income earned abroad by establishing a credit for foreign taxes paid against U.S., tax liability. A more detailed economic analysis of the Foreign Tax Credit is reserved for later in this chapter, and the legislative history of the Credit is reviewed in Appendix B.

In 1951 Congress substantially changed the treatment of mineral exploration expenditures (excluding those for oil and gas) by allowing them to be expensed through immediate deduction against taxable income. Initial limits on exploration deductions were eliminated in 1969, with the stipulation that, although expensable, exploration costs were subject to recapture through a corresponding reduction in allowable depletion deductions if and when a mine reached the producing stage.

When provisions for expensing mineral development outlays were enacted in 1921, Congress departed significantly from the concept that capital recovery be spread over the life of the asset in approximate proportion to the incremental losses in value. Developmental activities for access tunnels, site preparation, geophysical assays, and the like are analogous to the development and construction of buildings and machines for a planned manufacturing operation. In manufacturing such expenses are recovered gradually through depreciation deductions. Immediate recovery of mineral development costs which enhance the value of the mine over its entire life mismatches the timing of deductions with the actual decline in the value of the asset.

Another principle of capital asset recovery, that the total deductions equal the actual decline in asset value, was not violated when development costs became deductible. Discovery depletion permitted value as of the date af discovery to be recovered. Subsequent developmental costs had previously been capitalized and depreciated. In 1921 development costs

became immediately expensable against income; the only violation of the general principle of capital asset recovery was the mismatching of costs and deductions.

The substitution of percent depletion for discovery depletion did not necessarily result in a violation of capital asset recovery principles. If the sum of percent depletion deductions actually matched the full costs of discovering the mine, total deduction would match total costs. Of course, there was no longer any guarantee that the two figures for a given property would bear any close resemblance; capital costs could easily be more than fully recovered.

When exploration outlays also became expensable in 1951 the capital recovery principle was totally violated. Now the mining firm could deduct immediately the costs associated with prospecting for new properties. While this provision is laudable in that it closely matches deductions with costs, it enables discovery costs to be recovered more than once. Exploration costs up to a limit of $100,000 per year and limit of $400,000 over any four year period were immediately recoverable. For those firms using cost depletion for asset recovery, exploration costs in excess of these limits could be recovered gradually through depletion deductions. If a mining firm can deduct costs associated with making the discovery, the recovery of asset value through percent depletion is redundant. Firms were recovering some of the same costs twice. The relative impact of the “double deduction” was greatest for exploration outlays that remained under the statutory limit.

The 1969 Act eliminated any quantity limits on exploration deductions and substituted the new restriction that deductions on a property by property basis were subject to recapture if and when production commenced. Since the percent of all exploration outlays resulting in valuable discoveries is unknown, the amounts likely to be eventually recaptured are unpredictable. It has been suggested by mining industry spokesmen (Edwards cited in

Chapter 4)[1] that the odds against a mining claim turning into a profitable, producing mine may be as great as 10,000 to 1, but exploratory activity may also be highly concentrated on the better prospects. The fraction recaptured certainly would be more than .01 percent.

The net result of the 1969 Act was to permit double recovery of exploration costs up to the $400,000 limit, except for that fraction resulting in productive properties. And even on the latter fraction the deduction was recaptured without any interest penalty; in effect this gave the corporation an interest free loan until it was recaptured.

B. Miscellaneous Taxes and Subsidies

Although percent depletion and expensing of exploration and development are by far the most important elements distinguishing federal taxation mineral industries from corporations in general, several other provisions of state and federal policy deserve note. For many years some states have levied severance taxes on certain mineral outputs. More recently, the Federal Government established income tax deductions for corporations engaged in trade in the Western Hemisphere (WHTC) or engaged primarily in export trade (DISC).

(1) Severance Taxes-

Severance taxes, levied on either the quantity or value of output, are essentially excise taxes on mineral output. In an accounting sense, and in terms of economic incentives, severance taxes function exactly opposite to percent depletion deductions (See Chapter 6). It can also be shown that severance taxes act as an incentive to delay production - (See Peterson, among others) because the present value of profits from a mine (or forest) is not decreased, and is usually increased by postponing production when severance taxes are imposed. For this reason severance taxes are popular with conservationists.

Severance taxes are indistinguishable from production royalties. The

regional pattern of severance taxation strongly suggests that those states having the highest grade, most easily mined deposits also tend to have the highest severance taxes. Apparently severance taxes are viewed by states as a means of taxing economic rents accruing to the more profitable mineral deposits. Recently, Congress has considered the desirability of national severance taxes on mineral output. Some of the specific proposals are discussed in greater length in Chapter 4.

(2) Western Hemisphere Trade Corporations (WHTC)-

Since 1954, a United States corporation which controls a foreign based enterprise, such as a mining operation, can be organized as a WHTC. In order to qualify, the corporation must conduct its entire business (aside from incidental purchases) in North, South, and Central America, and the West Indies. Two further requirements are (1) 95 percent of the gross income for the current tax year and the two preceding tax years must be derived from sources outside of the U.S., and (2) 90 percent of such gross income must be derived from the active conduct of a trade or business.

WHTC's are commonly a subsidiary of an American parent corporation. The advantage of operating a WHTC is that approximately one-third of the WHTC's taxable income is deductable before tax. This special deduction is computed by multiplying the WHTC's taxable income by a fraction whose numerator is 14 percent, and whose denominator is the ordinary corporate tax rate. An additional feature of WHTC's is that corporate shareholders, most importantly the parent company, are not taxed on dividends earned but not yet received. Even when the dividends are distributed, the parent company is exempt from taxation on 85 percent to 100 percent of the dividends received.

(3) Domestic International Sales Corporation (DISC)-

Pursuant to a 1971 law designed to improve the United States' balance of trade, American corporations engaged in exporting domestically produced

goods are allowed to form a DISC. To qualify for DISC tax treatment, the corporation must derive 95 percent of its gross income from the exportation of goods to foreign countries.

DISC's are typically a subsidiary of a parent corporation engaged in producing the exported good. The DISC itself is not subject to the usual corporate income tax. Instead, the shareholders are taxed (at normal rates) on 50 percent of the earnings for each tax year whether distributed or not. The remaining 50 percent is taxed when distributed or when the shareholder sells, or otherwise disposes of, his shares.

Mining and timber companies were originally entitled to form DISC units, but the recent Tax Reduction Act of 1975 virtually eliminated this option for mining and timber. At present, a corporation engaged in exporting minerals (including timber) which enjoys a cost depletion or percentage depletion allowance can qualify as a DISC only if more than 50 percent of the value of the exported product is due to manufacturing processes exclusive of extraction, storage, transportation, and other similar costs.

C. Economic Analysis of Income Tax Subsidies for Mining

Although concurring that income from mining is taxed preferentially compared with general manufacturing, McDonald[2] has advanced theoretically based arguments in support of continued income tax subsidies to mineral industries. Other economists, in particular Musgrave,[3] have strenuously disputed both the assumptions and the theoretical approaches used to justify subsidization of mining. Subsidy arguments have been based on risk, capital intensity, and neutrality with respect to the taxation of foreign income.

(1) Subsidization through Foreign Tax Credit-

According to Musgrave the present U.S. approach to the taxation of foreign income attempts to incorporate several principles.[4] The resident principle dictates that the Treasury tax the world income of U.S. individuals

and U.S. corporations, except for unremitted profits in foreign subsidiaries. The source of income principle allows a foreign country to tax the income generated within its borders. Finally the principle of capital export neutrality requires that taxes should not affect the allocation of U.S. investment funds between countries.

The foreign tax credit represents an attempt to establish capital export neutrality by making the net total of all taxes paid per dollar of income identical, irrespective of the source of income. Domestic taxpayers may credit most foreign income taxes against domestic tax liability of foreign, but not domestic income. Capital export neutrality is essentially a world efficiency proposition; identical taxes irrespective of source of income will allow investment to flow throughout the world to where the return to investment is greatest. If higher after tax returns can be earned on foreign rather than domestic investments, U.S. welfare is increased by adopting a neutral stance with respect to income taxation.

An alternative view that foreign taxes merely represent a cost of doing business, and should be deducted from foreign income before domestic tax liability is computed, has some merit. In the recent past many oil royalty payments were thinly disguised as income taxes to qualify them for the foreign tax credit. This represents a violation of the intent of the principle of capital export neutrality; as Jenkins and Wright have demonstrated, net of tax rates of return to foreign oil operations have been unusually high.[5] Allowing foreign oil royalties to be treated as taxes has increased the differential in rates of return to oil investments rather than promoted capital export neutrality.

(2) Subsidies for Risk-

Central to the use of risk as an argument for tax subsidization is the notion that, because risks for individual firms engaged in mining are far greater than societal risks in mining, the supply of capital to the mining industry is undesirably low. The development of insurance

markets is one mechanism through which the investment distorting elements of individual risk can be reduced. Although the use of insurance to guarantee rewards to prospecting would probably be counterproductive because the element of risk is an important factor motivating certain individuals, there are other mechanisms for pooling of risks. The collectivization of risk through the aggregation of risk bearing units is a dominant theme in the history of the organizational structure of mining. The merger of several smaller operations into one parent corporation should reduce perceived risk in the financial community and thus lower capital costs. Lower capital costs continued to act as an impetus to further concentration in the mining industry.

If subsidies for risk in mining are to be given, they would be most productive directed to the smaller operators who face inelastic capital supplies because of perceived risk in small operations.

(3) Taxation and Economic Efficiency-

In a series of papers Harberger has persuasively developed the argument that differentials in income tax rates across industries create a distortion in investment allocations and a corresponding loss in economic welfare.[6,7] It is assumed that private investment decisions are guided by returns net of taxes. In this analysis existing differentials in the rates of taxation of income stimulate more investment in lightly taxed activities such as mining, timber, home ownership, and farming, and less in the more heavily taxed manufacturing sector, than would occur under a system of uniform income tax sates across industries.

Harberger's entire analysis has centered on economic efficiency in the market for capital as a factor of production. Societal returns to investments include tax receipts on earned income as well as the net of tax returns (after adjustment for risk and degree of concentration in an industry). Because excessive investment in lightly taxed industries lowers the pretax rate of return, greater societal returns to investment

would occur if funds could be removed from low tax activities and placed in industries subject to greater income tax burdens.

A related series of exchanges concerns the impact of income taxes in the product market. If taxes are to be non-distorting they should raise the price of all products by the same percent. McDonald observed that if income taxes are shifted forward onto final products, an income tax on capital would shift final output prices by the largest percentages in those industries having the greatest capital intensity (i.e., petroleum and metal mining). While acknowledging the validity of McDonald's argument, Musgrave noted that allocative efficiency is not the only criterion which should be considered. Equity must also be taken into account. Musgrave draws an interesting analogy to the personal sector of the economy. In the personal sector the most allocatively efficient tax would be a head tax. Obviously, it is impossible to attain this neutrality, due to considerations of equity.

McDonald's argument does offer some grounds for support of preferential taxation of capital intensive sectors of the economy. But in seeking allocative efficiency in the product market, the Harberger type of efficiency is introduced in the allocation of capital resources in the market for factors of production. McDonald shows that, in general, it is impossible to achieve efficiency in both markets simultaneously.

II. TIMBER TAXATION POLICY

A. History

The segregation of long-term capital gains from ordinary income for, tax purposes was introduced in the Revenue Act of 1922. At that time, it was felt that the taxation of capital gains at ordinary income tax rates discouraged individual taxpayers from selling their farms, mineral properties, and other capital assets. Whereas maximum ordinary income

tax rates for individuals was 40 percent under the 1922 Act, the maximum rate of capital gains for individuals was limited to 12.5 percent.

Prior to 1944, the definition of capital assets afforded capital gains tax treatment to only those timber owners who made an outright sale of standing timber, providing that the timber had been held for more than six months prior to the year in which it was cut. A further requirement was that the timber could not have been held by the owner for sale to customers in the ordinary course of business. Therefore, if a timber owner disposed of his timber in the course of his business, he was required to pay ordinary income tax rates on the profits from the sale. Similarly, a timber owner who cut his own timber for use in his own sawmill was also subject to ordinary income tax rates on the increased value of the timber when cut.

In 1944, the timber industry petitioned Congress for preferential tax treatment that, they argued, would promote equity between taxpaying timber owners, and promote conservation. Congress subsequently enacted Section 117(k) of the Internal Revenue Code - presently Section 631 - which extended capital gains and loss status to virtually all timber income. Specifically, capital gains tax treatment was granted to taxpayers who own timber and cut it, and also to timber owners who dispose of their timber under a cutting contract. The significance of this action was that owners of standing timber could cut it, or have it cut, and the profits would be taxed at the capital gains rates. Furthermore, no distinction was drawn between timber that was cut for sale or for use in the owner's business.

There has been little change in the timber tax subsidy since 1944. The House of Representatives unsuccessfully attempted in 1954 to prohibit the current expensing of certain costs allowable to timber not cut during the tax year, but the Senate (and final) version of the Internal Revenue Code of 1954 adopted one of the expensing provisions. In 1963, the

Kennedy Administration proposed (1) classifying all timber income as ordinary income (with some exceptions) and (2) allowing current expensing of reforestation costs. The proposals were rejected by the House in favor of placing timber income in the higher tax bracket of a two-tier capital gains classification system. As in 1954, the Senate adopted neither plan, and consequently, the Revenue Act of 1964 left the timber tax subsidy basically intact. There were no specific actions regarding timber in the Tax Reform Act of 1969, but the increase in capital gains tax rates to 30 percent for corporations also applied to the timber industry.

B. Capital Gains Theory

Many economists draw a distinction between "ordinary income" and "capital gains." Generally speaking, capital gains is that income which results from appreciation in value of a capital asset, and ordinary income is income from all other sources. It is sometimes pointed out that ordinary income is planned for, meaning that a person allocates his scarce resources in a manner so as to obtain this income. Capital gains, on the other hand, are unforeseen increases in the real value of one's assets, not directly attributable to one's efforts, intelligence, or risk taking (Seltzer). The purpose and intent of holding an asset supplies an additional basis for differentiation (Smith). Capital gains are held for investment, whereas ordinary income is used to replenish stock and inventory.

These differences are easily illustrated in a simple agricultural society where the annual crop is the basis of taxable income. If the harvest is particularly good in any given year due to unusually favorable weather, the excess over that needed for consumption will be used by the prudent farmer as seed to increase the next year's planting. This increase in the amount of seed available for planting is viewed as a capital gain, and the portion of the harvest which is to be consumed is the equivalent of ordinary income.

There are two major theoretical issues with respect to the taxation of capital gains. The first is: Given the nature of capital gains, is it fair to tax them? Those who favor taxation feel that it is most equitable to define taxable income as "total accretion," or more specifically, consumption plus the change in one's net worth (Musgrave). In this view, even though capital gains are not national income (i.e., production), they are still personal and spendable income which increases one's economic power in the sense of directing the allocation of resources, whether in the form of consumption or investment. Those who argue against capital gains taxation contend that capital gains are an accretion to capital which in turn produces taxable income. Aside from the merits of these arguments; the issue as a practical matter is largely moot because the United States, contrary to many other countries, has always taxed capital gains.

The second major issue is: What is the effect of a capital gains tax upon capital resource allocation? From an efficiency standpoint, a tax should not alter the flow of capital asset sales and purchases that would arise in a perfectly functioning market. However, when a tax is levied upon the increased value of a capital asset at realization (conversion to cash), the tax has a tendency to discourage the conversion of the asset into cash during any given tax year. This undesirable effect of the tax reduces the efficiency of capital resource allocation in the economy because capital assets are being held by people who do not make the most efficient use of them.

In view of the problems raised by the equity and capital resource allocation issues, the United States has adopted a compromise policy of taxing capital gains at rates lower than the ordinary income tax rates.

C. Timber and Capital Gains Theory

Timber is difficult to place within the capital gains framework previously developed. "Tree farming" (Mead) is a production process in which

land is used to grow trees, and the trees in turn manufacture wood fiber; wood is both the factory and the product. Affording timber income the status of capital gains implies that the annual joint product of land and treed (wood fiber) is transformed into a capital asset. However, the income derived from timber is readily broken down into two components: (1) real income in the national accounting sense from the production of wood fiber, and (2) income from increases in the price of standing timber. Transposed into terms, the former is identified with ordinary income taxed at the normal rate, and the latter is a traditional capital gain taxed at more favorable rates. Although the two components are easily conceptualized it is virtually impossible to assess their magnitudes for tax purposes in any given tract of timber. Consequently, it may be argued that since the annual accretion in value of a timber tract is primarily a result of the production function of trees, tree farming is more appropriately viewed as ordinary production, distinguished from other agricultural production primarily on the basis of a longer growth-to-maturity cycle, and should therefore be taxed as ordinary income and not as a capital gain. Voicing a dissenting view, representatives of the timber industry (particularly Wissing and Condrell) have argued that the long growing periods for timber entail unusual risks and, accordingly, the accretion in the value of standing timber should be taxed preferentially.

CHAPTER 2
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CHAPTER 3

THE EXTENT OF PREFERENTIAL TAXATION IN MINING AND TIMBER INDUSTRIES

In this chapter the magnitude of the tax burden is examined for a sample of mining, timber, paper, and manufacturing companies. There is, to our knowledge, no published summary of this information which incorporates both tax benefits from preferential taxation, as well as possibly adverse effects from property and severance taxes. The Securities and Exchange Commission requested that corporations report any expense constituting more than 1 percent of revenues as supplementary information to the income statement, beginning with 1973 10K reports. This data provides, the basis for an analysis of the differential rates of taxation on income from capital across industries.

In his study of income taxation by industry group, Rosenberg was unable to obtain a detailed breakdown of many of the taxes, especially property and severance taxes.[1] Assuming property tax rates are nearly uniform across industries, Rosenberg concluded that mining companies may pay nearly 80 percent of pre-tax income in various taxes, in contrast to an effective tax rate of less than 50 percent for manufacturing. (Rosenberg used the average property tax rate in manufacturing, and multiplied by net assets in mining to obtain property tax estimates for mining companies.) It would be incorrect to assert that mining companies receive preferential tax treatment if their total bill is really of this magnitude. The Rosenberg results should not be accepted without further inquiry, however, for the estimate of property taxes may be inaccurate to the extent that assets in mining are taxed differentially from those in manufacturing.

Two views of property taxation produce contradictory predictions as to the effective tax rate for property in mining and timber production, vis-a-vis manufacturing. One position holds that since a mine is immobile, even in the long run, there is a tendency for property tax rates to be higher than on more mobile capital in manufacturing. The taxation authority need not fear that capital will flee to a lower tax district, if the capital. is tied to production from a mineral deposit that continues to earn economic rents. The contrary view is that property tax rates in mining and timber production would be lower than in manufacturing because of the dominance of mining and timber firms in local economics and their consequent bargaining power to obtain preferential tax treatment.

Table 3-1 presents property taxes as a percent of net assets in plant, property and equipment for major corporations in the timber, paper and mining industries, as well as for a randomly selected group of large manufacturing concerns. Property tax rates for mining averaged 1.71 percent, for paper 2.16 percent, for timber 2.39 percent, and for manufacturing 2.73 percent. The latter figure compares with a figure of 1.79 percent for manufacturing used in the earlier Rosenberg study. Property tax rates have generally increased in the past decade and that alone could well explain the difference between the two estimates for manufacturing.

Several pieces of information suggest that the calculated property tax rates over-estimate the effective tax rate. Timber and paper companies carry timber lands at acquisition cost which is often far below current market value. For example, Pacific Lumber values its timber lands at $25 an acre in its balance sheet yet recently sold several thousand acres for $1500 an acre. Were assets to be valued at current market value the tax rate for the forest product industry would certainly decline substantially.

Table 3-1. PROPERTY TAX RATES FOR VARIOUS INDUSTRIES
(1973 data)

Integrated Forest Products:	
Georgia Pacific	1.50%
Boise Cascade	2.62
Weyerhaeuser	2.99
Southwest Forest Industries	2.10
Potlach	1.65
Pacific Lumber	4.96
Pope and Talbot	2.24
Bohemia	2.13
Champion International	1.76
Louisiana Pacific	1.90
Average	2.39
Paper:	
St. Regis Paper	2.24
International Paper	2.26
Westvaco	1.12
Scott Paper	2.26
Kimberly Clark	1.73
Union Camp	1.19
Great Northern Nekoosa	2.05
Crown Zellerbach	2.72
Long-view Fibre	3.88
Average	2.16
Mining:	
American Smelting Refining	3.00
AMAX	.71
Diamond Crystal Salt	2.28
Foote Mineral	2.02
Freeport Minerals	1.85
Kennecott Copper	1.34
Phelps Dodge	1.53
Pittston	1.68
Westmoreland Coal	.96
Average	1.71

Table 3-1 (continued). PROPERTY TAX RATES FOR VARIOUS INDUSTRIES

Metal Mining and Fabricating:	
Aluminum Corp. of America	1.34%
Bethlehem Steel	2.10
Republic Steel	2.69
Reynolds Metals	1.35
Average	1.87
Manufacturing:	
DuPont	3.18
American Home Products	2.92
Copperweld	3.12
Fort Howard Paper	2.24
Corning Glass Works	2.90
Dow Jones	3.23
General Mills	3.06
General Tire and Rubber	3.00
Goodyear Tire and Rubber	1.58
Westinghouse Electric	2.09
Average	2.73
Petroleum:	
Texaco	.85
Std. Oil Ohio	.84
Shell Oil	1.62
Atlantic Richfield	1.75
Average	1.27

Source: Derived from Corporation 10-K Reports.

ALTERNATIVE MEASURES OF THE TAX BURDEN

Depending upon one's definition of efficiency various measures of the tax burden can be established. Several ratios of taxes to income indicate an effective rate of taxation, and each ratio is calculated by using a slightly different view of efficiency. It is well recognized by economists that if tax rates differ across industries, there will be incentives for excessive investment in the low tax industries, and insufficient investment in the high tax industries. [2,3,4,5] In order to maximize the aggregate return on capital (assuming diminishing returns in each industry) one would invest in each industry until the rate of return to capital was equalized in all industries. In a world with no income taxes and a competitive form of organization, this result would be anticipated. Income taxes lower the net return to capital enjoyed by investors, and capital would tend to flow so as to equalize the after tax rate of return in each industry. If tax rates differ across industries, the allocation of capital is distorted from the allocation which maximizes the gross of tax returns (which are the actual returns to society - equalling profits plus taxes).

The national efficiency argument posits that investment should take place so as to equalize gross of tax returns domestically. Consequently it measures the rate of taxation on income after all foreign taxes have been paid.

Another measure of tax burden is that employed by the corporations in their 10-K reports to the Securities and Exchange Commission (SEC). In this report a reconciliation of tax rates is given; it explains why the "effective" tax rate, which is obtained by dividing the total of foreign, state, and federal income tax payments by pre-tax income, differed from the statutory 48 percent.

The world efficiency point of view is that the gross of tax returns should be equalized for all corporations, no matter where the income is earned. Clearly this view may be contrary to the interests of individual countries - this country would receive little direct benefit from foreign investments which are taxed at nearly 100 percent even though worldwide welfare may be enhanced by exceptional gross of tax returns. Multinational corporations, in arguing for retention of their current tax status, typically offer their total tax bill as evidence of a large tax burden relative to purely domestic corporations.

A commonly held view of taxation equity demands that realized Federal income tax rates be brought into approximate equality across industries. While the first three measures of tax burden may include all taxes (property, severance, and franchise, as well as all forms of income taxes), this view holds that only federal income tax payments should be included in the computation of the tax burden. This position has been espoused by Representative Vanik in arguing for a closure of tax "loopholes" enjoyed by multinational firms.[6]

Tables 3-2 through 3-6 portray rates of taxation of income from capital, as calculated by the four alternative methods previously discussed, for various industries including integrated forest products, pulp and paper, metal mining, integrated metal mining and fabrication, and a sample of manufacturing firms. By most measures the timber, paper, and mining firms enjoy preferential tax treatment relative to the sample of manufacturing firms. The average effective tax rate for each industry, as reported to the SEC, was 40.7 for forest products, 40.6 for pulp and paper, 25.5 for metal mining, 37.1 for metal mining and fabricating, and 45.9 for manufacturing.

In each industry group the principal sources of preferential taxation are delineated in a reconciliation. For the integrated forest products industry capital gains treatment of income is the most important

Formulas

$$\text{Domestic efficiency} = \frac{f + s + p + x + m}{y + p + x + m} \quad (1)$$

$$\text{SEC's effective rate} = \frac{f + s + g}{y} \quad (2)$$

$$\text{World efficiency} = \frac{f + s + g + p + x + m}{y + p + x + m} \quad (3)$$

$$\text{Federal Income Tax Rate} = \frac{f}{y - s - g} \quad (4)$$

where: y = income before taxes on income

f = federal income taxes

s = state income taxes

g = foreign income tax

p = property taxes

x = severance taxes

m = franchise taxes and other taxes

Table 3-2. TAXATION OF INTEGRATED FOREST PRODUCTS INDUSTRY

	Tax Burden			
Firm	Domestic Efficiency	Effective Rate Reported to SEC	World Efficiency	Federal Income Tax Rate
Bohemia	45.7%	43.5%	45.7%	40.5%
Champion Int'l	43.0	42.1	47.8	32.3
Georgia Pacific	45.2	41.	42.5	34.2
Louisiana Pac.	44.2	42.	44.2	+
Pacific Lumber	55.8	43.4	55.8	46.9
Pope & Talbot	30.0	43.3	44.4	27.8
Potlach	43.1	**36.**	43.1	27.3
S.W. Forest Ind.	47.7	42.6	47.7	36.6
Weyerhaeuser	53.4	32.	50.8	43.9
Average	45.3	40.7	46.9	36.2

	Reconciliation		
Firm	% Taxed at Capital Gains Rate	Reduction in Effective Rate from Capital Gains	Investment Tax Credit
Bohemia	43	**7.7**	2.2
Champion Int'l	29	5.3	2.5
Georgia Pacific	39	7	1
Louisiana Pac.	50	9	0
Pacific Lumber	53	**9.5**	0
Pope & Talbot	27	4.9	0
Potlach	86	15.4	3.8
S.W. Forest Ind.	27	4.9	3.3
Weyerhaeuser	78	14,	1
Average	48	8.6	

+ denotes unavailable
Source: Derived from Corporation 10-K Reports.

Table 3-3. TAXATION OF THE PULP AND PAPER INDUSTRY

Firm	Tax Burden: Domestic Efficiency	Tax Burden: Effective Rate Reported to SEC	Tax Burden: World Efficiency	Tax Burden: Federal Income Tax Rate
Crown Zellerbach	34.1	37.1	44.9	21.3
Great Northern Nekoosa	51.6	45.4	51.6	40.2
Kimberly Clark	33.5	46.7	49.2	27.2
International Paper	37.7	35.	43.3	31.4
Longview Fibre	43.5	38.9	43.5	38.9
St. Regis Paper	41.3	37.	52.7	40.3
Scott Paper	39.2	35.	44.3	28.1
Union Camp	46.6	44.0	46.6	+
Westvaco	47.6	46.1	48.6	42.5
Average	41.7	40.6	47.2	33.7

Firm	Reconciliation: % Taxed at Capital Gains Rate	Reconciliation: Reduction in Effective Rate from Capital Gains	Reconciliation: Investment Tax Credit
Crown Zellerbach	67	12.1	-
Great Northern Nekoosa	18	3.2	-
Kimberly Clark	11	2.	-
International Paper	40	7.2	2.2
Longview Fibre	44	8.	1.
St. Regis Paper	44	8.	3.
Scott Paper	89	16.	-
Union Camp	12	2.2	2.2
Westvaco	-	-	1.7
Average	36	6.5	

+ denotes unavailable
- denotes negligible
Source: Derived from Corporation 10-K Reports.
Note: Data on Mead Corp. excluded because 10-K Report did not contain relevant data.

Table 3-4. TAXATION OF THE MINING INDUSTRY

Tax Burden

Firm	Domestic Efficiency	Effective Rate Reported to SEC	World Efficiency	Federal Income Tax Rate
AMAX	25.6	28.8	37.4	20.1
Am. Smelting and Ref.	25.6	17.2	29.6	13.0
Anaconda	32.6	24.	36.3	18.6
Diamond Crystal Salt	32.8	42.6	33.8	29.0
Foote Mineral	47.9	25.	47.9	21.7
Homestake Mining	31.2	29.	31.2	28.9
Freeport Minerals	+	20.	+	39.2
Kennecott Copper	+	26.1	45.3	+
Phelps Dodge	43.2	26.1	45.3	35.5
Pittston	42.2	21.5	42.2	14.0
St. Joe Minerals	+	34.3	4	30.6
Westmoreland Coal	31.3	0.	31.3	0.
Average	34.7	25.5	37.9	22.8

Reconciliation

Firm	Percent Depletion	Investment Tax Credit	Foreign Income
AMAX	14	2.9	4.3
Am. Smelt. & Ref.	7.1	2.7	7.1
Anaconda	13	5	4.
Diamond Crystal Salt	+	+	+
Foote Mineral	26.1	11.9	-
Homestake Mining	15	5	-
Freeport Minerals	9		17.
Kennecott Copper	17.8 & 4.6 *	2.2	-
Phelps Dodge	9.0	1.9	-
Pittston	15.6	5.3	-
St. Joe Minerals	10.	3.	-
Westmoreland Coal	42.0		-

+ denotes unavailable
- denotes negligible
* The two depletion figures for Kennecott refer to minerals and coal respectively; total depletion benefit is 22.4.
Source: Derived from Corporation 10-K Reports.

Table 3-5. TAXATION OF METAL MINING AND FABRICATION INDUSTRY

Tax Burden

Firm	Domestic Efficiency	Effective Rate Reported to SEC	World Efficiency	Federal Income Tax Rate
Alcoa	32.6	34.6	46.8	+
Bethlehem Steel	47.2	42.0	48.7	37.0
Republic Steel	52.4	41.7	52.5	40.6
Reynolds Metals	39.1	29.5	46.6	14.9
Average	42.8	37.0	48.7	30.8

Reconciliation

Firm	Percent Depletion	Investment Tax Credit	Foreign Income	DISC & WHTC
Alcoa	3.3	6.7	-	3.4
Bethlehem	3.4	2.8	.5	1.
Republic Steel	3.5	3.2	-	-
Reynolds Metals *	4.	4.	-	4.

+ denotes unavailable
- denotes negligible
Source: Derived from Corporation 10-K Reports.
* Reynolds Metals obtained a reduction of 4 percentage points from capital gains.

Table 3-6. TAXATION OF MANUFACTURING

Firm	Tax Burden: Domestic Efficiency	Tax Burden: Effective Rate Reported to SEC	Tax Burden: World Efficiency	Tax Burden: Federal Income Tax Rate
Am. Air Filter	+	48.0	+	34.4
Am. Hoist & Der.	+	35.7	39.5	25.6
Am. Home Prod.	44.4	49.7	50.9	40.1
Copperweld	51.7	47.6	51.7	44.5
Corning Glass W.	+	50.8	55.2	+
Duro-Test	50.7	47.5	50.7	+
DuPont	45.6	46.3	50.0	41.3
Dow Jones	52.6	51.2	52.6	47.4
Gerber Prod.	+	47.5	52.1	+
General Mills	51.8	39.6	51.8	36.6
Goodyear T. & R.	50.1	45.3	55.4	34.8
Proctor & Gamble	45.8	44.9	51.6	36.9
Safeway Stores	54.9	45.2	59.5	33.6
Westinghouse Elec.	54.7	43.5	54.7	33.2
Xerox	36.7	45.7	50.9	24.2
Average	49.0	45.9	51.9	38.6

+ Denotes unavailable
Source: Derived from Corporation 10-K Reports

tax benefit; it is obtained on an average of 48 percent of the income for the firms in the sample, and reduces their effective tax rate by 8.6 percentage points. (It should be noted that foreign income and foreign income taxes can introduce errors into the estimate of the percent of income taxed at capital gains rates.) For the pulp and paper industry capital gains is also its most important tax benefit; it is obtained on 36 percent of the income for the firms sampled, and reduces their effective tax rate an average of 6.5 percentage points.

For the mining industry percent depletion is by far the most important tax benefit. For this sample of firms it served to reduce the effective tax rate by anywhere from 9 to 42 percentage points. The investment tax credit and the foreign income tax credit against domestic income tax liability are also significant factors reducing effective tax rates.

When rates of taxation of corporate income are measured by dividing the sum of all taxes (e.g. property taxes plus franchise taxes plus severance taxes plus income taxes) by income before any of these taxes were paid, the same variation across industries is observed. The forest products industry averaged 46.9 percent by this measure, pulp and paper 47.2 percent, mining 37.9 percent, mining and fabricating 48.6 percent, and manufacturing 51.9 percent.

In Tables 3-2 through 3-6 several figures are recorded as unavailable. This reflects the common practice of reporting aggregate figures for certain types of taxes. For example, state and foreign income taxes are reported in aggregate, but not separately by Louisiana Pacific and Duro-Test. Others (Gerber and Kennecott) failed to distinguish between foreign and Federal income taxes. Finally property taxes are often included with other non-income taxes, making the computation of the property tax rate impossible for those firms included in Tables 3-2 through 3-6 but excluded from Table 3-1.

CHAPTER 3

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CHARTER 4

THE REGULATION OF MINERAL DISCOVERY AND PRODUCTION ON FEDERAL LANDS

This chapter diverges somewhat from the major theme of this report to consider economic aspects of present and proposed systems for regulating the discovery and production of minerals on federally owned lands. The proposed revisions of existing law are especially interesting to us in that most would impose new taxes on the mining industry that conceivably could eliminate much of the present subsidization obtained from percent depletion and expensing of exploration and development costs.

The discovery of hardrock minerals is regulated by the General Mining Law of 1872[1] which allows prospectors open access on unclaimed, open public domain lands in the Western United States. Our criteria for evaluating alternative procedures for the discovery of minerals include equity, efficiency, and administrative feasibility. Equity considerations, involving the distribution of income and wealth among present as well as future generations, center on issues such as the timing of discovery and development, and the allocation of economic rents between private and public ownership. Economic efficiency, satisfied when a given output is achieved at least cost to society, is violated when the search for minerals involves unnecessary and unproductive expenditures, as well as when the costs of environmental disruption resulting from mineral exploration and production are not incorporated in mining firms' decision-making. Administrative feasibility refers to monetary and non-monetary costs incurred by the administrators as well as those subject to the regulations.

Present policy fails in several respects to satisfy the criteria for evaluation. There is no centralized management over the timing of exploratory effort. The discovery process rewards exploration by giving away valuable mineral assets rather than offering exploration rights for sale by competitive bid. Although appropriate incentives exist for individuals to produce so as to maximize the present value of economic rents, few if any of these rents accrue directly to the federal treasury. Additionally, the taxation system that does exist serves in part to distort private incentives away from maximization of the rent accruing to all of society. Because of open access there is excessive exploration and the last prospectors to join the hunt for minerals do not contribute as much to the rest of society as they could in alternative forms of employment. A second form of inefficiency is created by the legal system under which claims are filed, and a third inefficiency from the failure to internalize the costs of environmental disruption. Although accumulated experience has demonstrated the feasibility of the General Mining Law, costs incurred by the Department of the Interior in challenging the validity of mining claims and related costs incurred by the mining industry to defend challenged claims have been substantial, judging by the volume of litigation recorded over the past 100 years. In addition to the costs, the fact that the Department of the Interior has records neither of who has claim on which parcels of land nor of the extent of mining following the issuance of mineral patents indicates that the Mining Law leaves much to be desired administratively.

I. THE DISCOVERY PROCESS

The image of the sourdough prospector coaxing his burro through the untamed West is a bit exaggerated today. Today's prospector may drive a Jeep, have access to modern seismic data and other geophysical information, and possess other new prospecting tools. He may be self-employed,-hut more often works for the mineral exploration arm of a major mining company. The lure of a big strike next time has attracted individuals into this employment out of all

proportion to the wages to be earned. Despite the attractiveness of risky propositions to certain individuals, incentives for lone prospectors are rapidly diminishing. Recent developments in capital intensive forms of exploration, such as diamond drilling, airborne magnetic surveys and chemical assays of aquifers by the larger mining companies, have largely supplanted individual effort as a source of new discoveries.[2]

Mining rights on most of the open public domain lands, as distinguished from "acquired lands" which have been obtained through purchase or acquisition from private individuals, are obtained through discovery and development. Exploration proceeds without restraint until a showing of "valuable" minerals is obtained. At that point a prospector can stake a claim for mineral rights under the Mining Law of 1872.[3] The requirement of a "valuable" showing is relevant to maintaining a claim only when the validity of the claim is challenged, and the vast majority of claims eventually prove to be worthless from the standpoint of mineral production. Claims can be of four types: lode claims which follow along a vein of mineralization, placer claims on a 20-acre rectangular parcel, tunnel sites, and mill sites on 5 acres of non-mineral land. To date in excess of 6 million claims are thought to have been filed, many of which have been abandoned. To maintain a valid claim at least $100 worth of effort must be sustained in each year. Under the Mining Law a claim may be voided by a subsequent prospector or the Department of the Interior if $100 of effort each year cannot be proven by the claimant. The effort requirement has been criticized because it is all too often satisfied by the claimant making purposeless scars on the land. In cases where overlapping claims have been filed or boundary designations are subject to dispute, litigation in state courts often ensues.

Surface rights to a mining claim may be obtained through patenting

a claim, a long and expensive process, especially in recent years. The requirements include payment of a fee of $2.50 per acre for placer claims or $5.00 per acre for lode claims, and evidence of the possibility of profitable recovery of minerals. Approximately 64,000 patents covering some 2.9 million acres have been granted since 1872[4] (see Figure I). Though patenting confers several definite advantages to the owner of a mining claim including fee ownership of the land, the elimination of possible challenges from other claimants or governmental agencies, and increased ease of financing through outside sources, patenting also has a distinct disadvantage. The patenting process involves both procedural and substantive requirements, and a claim is invalidated if it is determined that the requirements have not been satisfied. A patent applicant thus faces the real risk of losing his claim should the patent be denied.

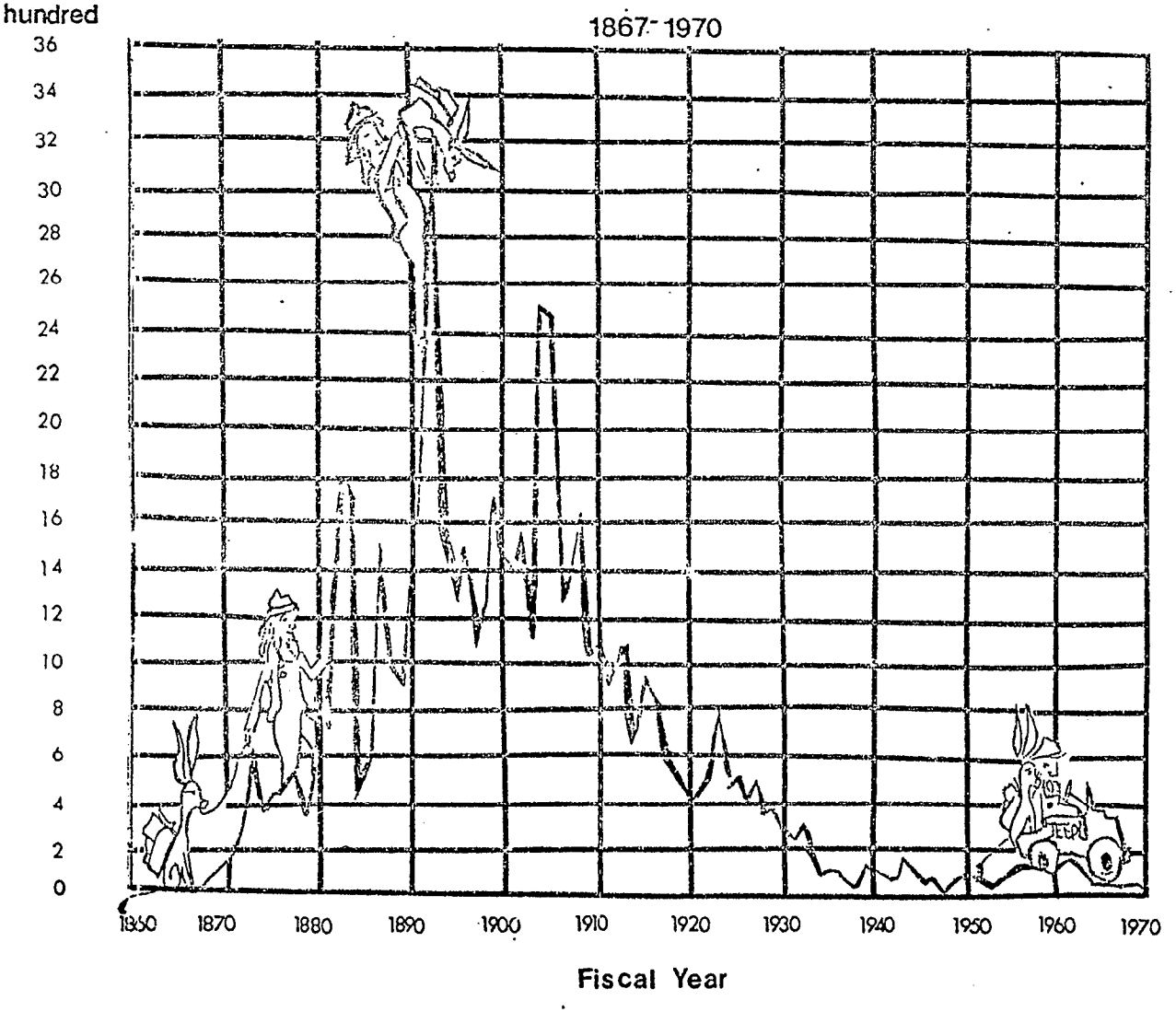
In the 1920 Mineral Leasing Act[5] certain minerals, primarily coal, oil and gas, were excluded from disposition under the Mining Law. By 1973 some 68 million acres of Federal lands were under lease for oil and gas and about 800,000 acres were under lease for coal.[6] The Material Disposal Law of 1947[7] and its extension, the Multiple Surface Use Act of 1955[8], excluded several common materials such as sand, gravel, pumice, and clay from location under the Mining Law and provided for their sale at fair market value.

The main difference among the three mechanisms for mineral development is that the Mining Law of 1872 acts as a self-executing law and does not allow the Secretary of the Interior to weigh alternative public values as he may do under the other systems of development before approving applications for title. Under the Mining Law of 1872 the Secretary has utilized two basic approaches to deny the statutory grant of rights in situations where he feels mineral development is inconsistent with proper land use policy. First,

FIGURE 4-1

MINERAL PATENTS ISSUED

1867-1970



he may withdraw lands from the domain of public land laws, rendering the Mining Law inoperable. The second approach has been to apply increasingly restrictive tests for the determination of value.

In the absence of Congressional reform of the Mining Law for the disposition of hardrock minerals, the Department of the Interior, through decisions rendered by the Secretary of the Interior until 1952, the Solicitor of the Department of the Interior from 1952 to 1970, and the Board of Land Appeals since 1970, effected indirect reform through increasingly strict interpretations of the Law. The terms "valuable" and "discovery" in the 1872 Law were defined in the case Castle v. Womble[9] in what has subsequently become known as the "prudent man rule".[10] This rule indicates that there is value when a "man of ordinary prudence would be justified in the further expenditure of his labor and means, with a reasonable prospect of success, in developing a valuable mine..."[11] Although the language of Castle v. Womble makes no explicit mention of profitability, the Department of the Interior, in a long series of subsequent decisions, held that the prudent man would take into account prospective profitability before investing his labor and means.[12] The marketability test of value, as it came to be known, reached its final explication in United States v. Coleman[13] with the Secretary's decision that present marketability at a profit was required for discovery. Though the marketability test of value may be deemed desirable by the Secretary for unstated social purposes, it diverges significantly from the conventional economic test in which value is associated with positive market prices. For example, the title to low-grade copper deposits may be of substantial value to those willing to speculate on rising prices in the future or on the development of new techniques of extraction, yet the copper deposit may be highly unprofitable should it be mined today.

The use of mining claims for purposes other than mining has been extensive. Under the Mining Law of 1872 the owner of a mining claim has the right to disturb the surface in search for minerals, including such acts as cutting timber and erecting structures necessary for mining operations. In some cases summer homes have been built on otherwise worthless mining claims. [14] The owners face the risk that the Federal Government may challenge their claim on the grounds that valuable minerals have not been found. If the challenge is sustained the property reverts to government ownership. Others have filed mining claims on land in the path of urban growth (as in the thousands of claims for sand and gravel near Las Vegas) hoping to profit from use of the land as a commercial site.

Mining claims, though filed for a specific mineral, convey the right to remove other minerals. As relative mineral values change, old claims may be challenged in state courts by those who would like to obtain mining rights for other minerals. The challenge may be on the grounds that the boundaries of the original claim were incorrectly specified, that less than the requisite $100 effort has been done yearly, that the "valuable" discovery has not been made, and a host of other points.

The discovery procedure frequently acts perversely when it serves to retard the production of minerals. The area surrounding the site of a major discovery usually becomes dotted with other speculative claims which may hinder further development. Not only is it expensive to negotiate with so many different claimants, but each one has an incentive to hold out for a disproportionate share of anticipated future profits. Dormant mining claims serve as a deterrent to new exploration because of the significant costs of having them declared invalid.

Development of a mining property involves capital requirements on a scale which normally requires access to financial markets. Because of risk reduction through diversification of activities, the larger mining companies are able to obtain financing on more favorable terms than would the lone prospector. Capital requirements force the owners of many undeveloped mining claims to solicit offers from the major mining companies if the properties are ever to reach the producing stage. The larger mining companies have obtained much of their producing property in this fashion.

Prospecting on closed (private) land differs from that on public open access land in that some bonus, lease, or royalty is normally arranged before prospecting begins. The landlord captures some of the rent and prospecting is less motivated. Another factor which tends to limit exploration on private lands is that the rational landowner would want to postpone exploration effort in the hope that exploration on adjoining properties would reveal information as to the mineral content of his property.

A third land tenure arrangement has evolved on former public domain lands where surface rights have been disposed of through statute. The separation of surface and mineral rights on these lands has led to a number of unfortunate situations where mineral exploration and even mining occurs in residential areas.

Factors other than the General Mining Law which affect industry decisions on the timing of and investment in exploration include the nature of competition in the industry and Federal and state tax policy toward the mineral industry. The industry setting of imperfect competition serves to stimulate preclusive preemption to the industry base to strengthen competitive positions. Firms place a high value on the discovery of resources because they may later be rewarded by monopoly rents. Vertically integrated firms

often attempt to gain control of raw material supplies. Mancke observed this tendency in the steel industry in the late nineteenth century, the apparent motivation of the steel producers being to prevent the formation of an iron ore cartel that might threaten the profitability enjoyed by the steel industry.[15]

Federal tax policy appears to operate to stimulate exploration, though a comprehensive review of the effects is beyond the scope of this paper. On balance the expensing of exploration and development expenditures serves as an interest-free loan from the treasury in the amount of the deductions, when one compares this policy with the alternative of treating such outlays as investments. Though Miller has argued that percent depletion discourages exploration, it would appear that by making mineral discoveries more valuable, percent depletion would serve to stimulate exploration effort.[16]

The effect of the property tax on exploration deserves special consideration. Mining claims are not subject to a property tax until they are patented. Minerals can be removed from unpatented claims, making the impact of property taxes on exploratory efforts on open public lands minimal. On private lands property taxes may be revised upward following mineral discovery. This factor may serve to reduce the incentive to explore. The administration of property taxes is an extraordinarily complex subject involving thousands of rates, districts, and administrative decisions. Any impact of property taxes on exploration efforts could be minimized by reducing taxes on properties where mineral production is uneconomic, while raising it in successful properties.

II. ECONOMIC CONSIDERATIONS FOB OPTIMIZATION IN EXPLORATION

There are two basic tests of the social desirability of the discovery process. First, is exploration effort timed in a manner that is consistent with national policy objectives? Second, are inputs to the discovery process used efficiently? Because there is little, if any, governmental regulation or other form of influence on the timing of exploration, there may be a divergence between decisions made by the mining industry and national policy objectives. The legal setting of open access favors the inefficient use of exploration inputs; in addition, the decentralized and often lax recording of claims needlessly increases discovery costs.

That exploration should precede production by many years is suggested by information requirements regarding the quality and extent of domestic ore supplies which should be an input to the development of a national materials policy. Additionally, if the commencement of production is to be optimally timed, the values of all mineral leases and claims should be accurately known. This is difficult in the face of the tremendous uncertainty which precedes thorough exploration. Certainly the reticence of the mining industry to reveal the true extent of probable reserves compounds the difficulty of making Federal mineral policies. A factor which argues against complete knowledge of reserves is that idle reserves in and of themselves are not productive. If social welfare is to be measured strictly by output, society would be better off to defer exploration outlays until just before production is scheduled to begin, and channel investment funds into productive areas in the interim. Moreover, as technological improvement in exploration continues, the real costs of discovery should decline, further arguing for a slowing of the pace of exploration. As long as the timing of exploration is controlled by mining firms rather than subject to some form of central control, there is a strong chance timing

will be premature from the viewpoint of society as a whole. Rather than being motivated by national policy objectives the individual firms are stimulated to explore by profit-maximizing considerations. Individual profit-maximizing behavior fails to maximize societal welfare both when the rate at which future profits are discounted by individuals differs from the social rate of discount, and when individuals are induced to explore in order to strengthen market positions.

The second question to consider is efficiency in exploration. In theory, and ignoring considerations of risk, inputs to any production process should continue to be hired so long as the value of their marginal product continues to exceed their cost. For mineral exploration there is no central authority with the responsibility for the determination of the marginal productivity of additional prospecting effort. Individuals are guided in their decision to prospect by the expected (average) wage in the industry (or may be willing to accept even less if they are attracted by the remote prospect of a big strike). Assuming diminishing returns to prospecting, as a result of a decline in the quality of lands being searched, the average wage will exceed the incremental value of the contribution to total discovery value made by the last few prospectors. These marginal prospectors, though themselves earning the average wage, depress the incomes of the earlier entrants to the field, so that in terms of their net contribution to discoveries their effort is unjustified. Again individual profit-maximizing decisions lead to a lower level of social welfare than would occur under centralized management of exploration.

Although we have in principle answered the question of the optimal amount of prospecting effort, there exist a number of possible externalities which could alter the conditions for optimality.

They include:

(1) An information externality in that one discovery may make it easier to find minerals in the same or similar geological formations.

(2) An exploration externality resulting from duplication of effort - searching the same land more than once.

(3) The "Easter Egg" externality in that each discovery increases the cost to all other prospectors in making their next discovery. [17] (There are a fixed number of mineral deposits and finding one makes it just that much more difficult to find the next one.)

In commenting on these externalities we note that a beneficial externality, such as the first, would require the optimal exploration effort to be greater than indicated by the marginal productivity criterion, whereas a negative externality, such as the second, would indicate the criterion calls for excessive exploration. The third externality deserves special consideration. It is true that each successive discovery raises the cost of subsequent discoveries, especially in the absence of externalities of the first type. If one views exploration as a sequential searching process, identical prospecting efforts in successive years will be expected to yield progressively lower returns. This is merely the famous "pecuniary" externality where firms face a rising supply curve for an input (mineral reserves) and appropriation of the input by one firm raises the cost to subsequent users. As such it does not result in a misallocation of resources and calls for no deviation from the optimality criterion.

III ECONOMIC CONSIDERATIONS FOR OPTIMIZATION IN PRODUCTION

In theory (and probably in practice) the production of minerals by corporations is governed by the maximization of the present value

of profits from a mine. Thus production decisions are affected by profitability variables such as taxation, ore grade, mineral prices, and extraction technology, all of which are factors unrelated to the operation of the General Mining Law. The primary, if not the only, function of the General Mining Law is control over the process by which the ownership of minerals in place is transferred from public to private hands. As we argue below, the neutrality of the Mining Law with respect to production decisions permits the attainment of the same social welfare optimum that would result from the unrestricted activities of individual mining companies. Most recent proposals to revise the Mining Law would affect production decisions, either through taxation, royalties on leaseholds, or requirements that production commence within a stated period to maintain rights to a leasehold. This section examines the impact of taxation and other regulatory mechanisms on the production decisions of mining firms as a prelude to the critical evaluation of the proposals to revise the Mining Law.

The maximization of the present value of producer's plus consumer's surplus will be used as the criterion of optimality in production. This choice may appear a bit artificial, but it has been used previously in intertemporal models and as Peterson shows is equivalent to efficiency in the more conventional terms of price and marginal cost.[18] Hotelling first demonstrated the efficiency of a competitive mining industry.[19] He showed that a competitive industry which maximizes the present value of profits chooses exactly the same production path as a centrally planned economy which maximizes the present value of producer's plus consumer's surplus. A monopolistically controlled industry would fail to achieve optimality by maintaining a difference between price and marginal cost. Compared with the centrally planned economy's production path the monopolist restricts output.

In the competitive model firms maximize the present value of profits, which is just the present value of producer's surplus (the difference between price and long-run marginal cost), and may properly be termed economic rent when marginal cost measures the opportunity cost of each input. Economists have long argued that taxation of rent is socially desirable, such taxes being non-distorting. Additionally one might argue that mineral production on public lands should not earn long-run profits above the minimum necessary to attract the investment that does take place. Equity with respect to the allocation of public resources would indicate that some (the mining companies) should not benefit at the expense of the many.

We are led then to an examination of the effect of various forms of taxation on the allocation of rents and on the optimal timing of production. Hotelling and Peterson both analyzed the impact of taxation on production. Their results are summarized below. A pure profits tax is a tax on economic rents; it does not distort the timing of production from that which is socially optimal. The

Tax	Effect on Timing of Production
pure profits	neutral
income	delayed
severance	delayed
property	advance or neutral

income tax distorts production decisions because of the manner in which investment is treated. Rather than being written off as incurred, investment for exploration and development of productive ventures must be capitalized and depreciated over time. The depletion allowance as it is written in the tax code serves to accelerate the timing of production over what it would be with ordinary income taxation. In recent sessions of Congress hearings have been held on legislation that would impose a Federal severance tax or royalty payment on output. A severance tax would have the consequence of postponing

output and would also serve to transfer some of the economic rent to the Federal government.

Taxes such as royalties and severance taxes serve to lessen the differential in value between the use of land for mineral production and some alternative purpose, even if the alternative use is merely to serve the needs of an occasional hiker or hunter. As long as the land continues to be used for mineral production the government obtains a share of the rent that previously accrued to the owner of the land. By applying royalties or severances on the gross value of output, the extensive margin of land use for mineral production will be curtailed. [20] A tax on net receipts (accounting profits) would be better in that more profitable operations would pay larger taxes per ton of ore removed, but better still would be a tax on pure economic profit (rent). In theory this would be administered by taxing only that portion of profits from each operation above that which reflects a normal rate of return on the investment (properly adjusted for risk).

IV. REVISING THE MINING LAW OF 1872

Significant modification of the General Mining Law occurred with the enactment of the Mineral Leasing Acts of 1920 and 1947 [21] and the Material Disposal Law of 1947. [22] The former served to exclude most energy minerals from location through the Mining Law, and the latter provided for the sale of common materials such as sand, gravel, and clay obtained on public lands at fair market value. The wisdom of having three separate systems for the development of minerals on Federal lands is questionable, especially considering that the minerals subject to disposal under different systems may be intermingled in the same deposit. The Multiple Mineral Development Act [23] was an explicit attempt to deal with this problem of administration. The passage of the National Wilderness Areas Preservation Act [24] and the establishment of the Public Land Law Review Commission [25]

presaged a revival of interest in an examination of the desirability of the Mining Law as an instrument of national policy.

Most of the land that was placed in wilderness status by the National Wilderness Areas Preservation Act had been open to mining and in many areas claims had been filed and even patented. Rather than halt all current mining efforts or deny rights that had already been conferred through patenting, Congress opted to allow prospecting and mining until January 1, 1984, presumably a sufficient time to allow fixed investments to be recovered. The Act specifies that it is Federal policy "to secure for the American people of present and future generations the benefits of an enduring resource of wilderness."

In the act establishing the Public Land Law Review Commission

> "it is hereby declared to be the policy of Congress that the public lands of the United States shall be (a) retained and managed, or (b) disposed of, all in a manner to provide the maximum benefit for the general public."

By this declaration Congress reinforced the trend away from what some have viewed as indiscriminant disposal of Federal lands under such laws as the Homestead Law[26] and the General Mining Law. As land became more scarce, disposal as an instrument of public policy gave way to leasing and sale through competitive bidding. The open access to minerals on public lands is one of the few remaining vestiges of our former national policy.

The Mineral Leasing Act of 1920 excluded most energy minerals from location and provided for the awarding of lease privileges through competitive bidding. By leasing, rather than allowing open access, the dissipation of economic rent through excessive and premature exploration can be eliminated. Presumably the Interior Department can weigh the social benefits from alternative uses of Federal lands before it decides to offer them for lease. Also the regulation of mining activity is simplified if tracts are large and records

of ownership are kept in a single location. The welfare of future generations may or may not be factored into governmental decisions but at least there is reason to believe it will be given more weight than in private decisions to explore when open access is allowed. Uncertainties associated with possible withdrawal of exploration rights still exist as a deterrent to prospecting effort and may serve to adversely affect bidding for oil and gas leases.

The principal defect of the Mineral Leasing Act of 1920, from the viewpoint of economic efficiency, is the manner in which production leases are awarded for lands not known to be mineralized. The Act specifies that parties interested in obtaining a noncompetitive oil or gas lease must file simultaneously, the winner to be chosen in a random drawing. Typically, parties awarded the leases are not in the petroleum industry and sell the lease to one of the major petroleum companies in a contract that provides for a royalty to the seller. No part of this royalty accrues to the Federal government (other than through income taxation). This system encourages excessive investment in the socially nonproductive act of filing for the leases. Social welfare would be increased if this nonproductive effort was discouraged and a system of competitive bidding established (as is done for lands known to be mineralized).

The leasing process for coal and phosphates requires that they often be granted without competition, a system that may, depending upon leasing fees, transfer economic rent from the Federal government to private investors.

At least four bills were introduced recently in Congress that would modify the operation of the Mining Law of 1872 as it pertains to hardrock minerals. These are S 1040, the proposed "Mineral Leasing Act of 1973;" S 3085, the proposed “Hardrock Mineral Development Act of 1974;" S 3086, the proposed "Mineral Development Act of 1974;"

and HR 8435, the proposed "Mineral Leasing Act of 1975." The following paragraph outline the provisions of each of these bills and analyze their efficacy in producing socially desirable changes in the Mining Law.

S 1040, which was supported by the Administration and the Interior Department and strongly opposed by the organized mining interests, would have repealed the Mining Law of 1872, the Mineral Leasing Act of 1920, and related laws, and in their place would have:

(1) Instituted a system of leasing for the exploration of all minerals. The leases would have been issued by competitive bid only when there was evidence of minerals in paying quantities; otherwise leases would have been issued without charge, and would have been valid for a period of ten years.

(2) Instituted a second type of lease for production, valid for from five to twenty years and automatically renewable if minerals were being produced.

(3) Established minimum annual rental fees per acre on all leases.

(4) Established a minimum royalty on production.

(5) Required submission of plans for operation and reclamation prior to commencement of mining, and compliance with these plans throughout.

(6) Given the Secretary of the Interior the authority to remove lands from the operation of the Act to protect the environment or to promote alternative uses of the land, and also given the Secretary the right to waive or reduce fees and royalties on certain properties to encourage development.

(7) Limited hardrock mineral leaseholdings under control of one corporation to 20,480 acres in one state and 640 acres in one lease.

(8) Required that all existing claims be recorded within one year of enactment of the Act and a patent applied for within three years.

If properly implemented by the Secretary of the Interior, this bill would have corrected the major objections to the Mining Law of 1872 previously raised. Timing of exploration would have been under centralized management, and with restrictions on entry there would have been far less of an incentive to excessive exploration effort. With entry restrictions on a lease, decentralized prospecting decisions are (theoretically, at least) guided by a prospector's marginal product, a force that should lead to efficient use of prospecting inputs. Uncertainties over ownership would have been resolved. Larger leases should eliminate the externalities associated with excessive adjacent claim filing near productive discoveries. Control over use and the evaluation of alternative land uses would have rested with the Secretary, who presumably would make decisions consistent with the maximization of social welfare.

Contrary to the remarks of Howard Edwards of the Anaconda Company that offering leases through competitive bidding, as proposed by this bill, "...is not a fair way to allocate leases because the practice discriminates against small miners, is an economic waste, discourages development and investment..." [27], the taxation of true economic rent (as in a bid for a lease) is desirable because it serves to allocate investment according to the marginal productivity criterion. It is true that bidding for leases can involve substantial sums and this factor would definitely serve to deter the small prospector. In the past the small prospector has been instrumental in the discovery process; Koehler Stout, President of the Montana Mining Congress, terms them the "bird dogs" of the industry. [33] If their efforts truly are more productive than similar outlays by large mining companies, the interests of both prospectors and

mining companies would be served by formalizing their relationship in an employment contract (containing suitable incentives for discovery).

The "Hardrock Mineral Development Act of 1974," S 3085, is similar to S 1040 with the following exceptions:

(1) It would have applied only to hardrock minerals.

(2) It did not specify guidelines for competitive bidding on leases.

(3) It did not specify that the Secretary would have discretion over the issuance of exploration leases.

(4) Production leases could have been held for 40 years without any production as compared to 20 years under S 1040.

The differences between S 3085 and S 1040 were primarily in the scope of coverage and the authority vested in the Secretary. The economic implications are clear. Inefficiencies in other than hardrock mineral exploration and production would not necessarily be subject to evaluation by a centralized decision-making unit. Also the absence of competitive bidding for leases would result in a loss of economic rent to society and its appropriation by the winner of the lease.

The proposed "Mineral Development Act of 1974," S 3086, was preferred by the American Mining Congress, an association of large mining companies, and was opposed by (1) various smaller associations representing lesser mining companies for whom capital requirements would have been burdensome, and (2) the Department of the Interior. Among other things this Act would have:

(1) Provided for the elimination of existing unpatented claims unless a new claim was filed within five years of the date of enactment of the Act.

(2) Had new claims recorded both in the county recording office and in the regional office of the Bureau of Land Management, and filed for 80 acres in a manner that conforms with legal subdivisions of public land.

(3) Eliminated the present distinction between lode and placer claims.

(4) Increased the annual labor requirements substantially.

(5) Continued the present system of patenting, though only at a substantially higher fee. Patents would have only conferred the right to extract minerals and would not have allowed full freedom to utilize the site for other purposes as is the case under present law.

(6) Instituted a system of royalties of 2% of the value of minerals mined subject to the restriction the royalty be less that 5% of net income.

This bill would have resolved many of the ambiguities over ownership by eliminating all old claims for which there was no current active interest. By collecting all claim information in a central repository (BLM), potential claimants should enjoy significantly lower search costs in determining whether or not a given parcel has been claimed. Presumably the provisions restricting use of patented sites to only those directly connected with the production of minerals would have eliminated the abuses that have occurred on these sites.

The provisions for environmental protection in these bills differed substantially in degree. S 1040 would have had the most stringent requirements, the operation and reclamation plans which would have had to have been approved before development and followed thereafter. S 3085 would have been less restrictive by not requiring such comprehensive planning, nor would it specifically have vested authority in the Secretary to reject the issuance of exploration leases or

bids for leases when he felt it was in the public interest to do so, as he could under S 1040. S 3086 would have given the Secretary even less authority to deal with problems of multiple use and environmental damage.

HR 8435, the proposed "Mineral Leasing Act of 1975," was drafted largely by Lawrence MacDonald, a Colorado School of Mines professor of economics. This bill would revise the entire system for mineral disposal including hardrock minerals, oil and gas, construction materials, and bedded minerals such as oil shale and sulfur. The existing systems would be replaced by a three-stage leasing system in which the Federal government would retain ownership and control over the land. Strong environmental safeguards would accompany each stage. Inasmuch as the principal concern of this paper is hardrock mineral development under the General Mining Law, the discussion of HR 8435 will deal primarily with the regulation of hardrock mineral development.

In stage one the Secretary of the Interior would, at his discretion, issue a prospecting permit allowing only surface reconnaissance to any person making a valid application. Each permit would be valid for a period of two years and would be subject to a nominal fee to cover administrative costs.

In stage two exploration leases would be issued which would give exclusive exploration rights to the leaseholder. Where two or more persons file exploration applications on substantially overlapping territory, the Secretary would offer the lease competitively to the highest bidder. A rental fee of at least 50¢ per acre per year would be charged; the size of each lease would be limited to a maximum of 640 acres; and the extraction of minerals would be limited to quantities required for chemical analysis.

In the third stage a development and production lease would be issued by the Secretary to persons showing that deposits exist in paying quantities. Lease applications would be able to be revised to include other minerals should they be discovered during subsequent development. Leases would be issued for a twenty-year term and continue thereafter as long as production continued. A fee of at least $1 per acre per year would be imposed and the fee would be increased each year following the sixth if production had not commenced. Before extraction operations could begin a comprehensive plan for operations and reclamation would have to be approved by the Secretary.

Holders of existing mining claims would be forced to record them within one year of the date of the Act, and to file an application for a patent or a development lease within three years of recordation of the claim.

HR 8435 would eliminate most of the undesirable features of discovery under the General Mining Law. Furthermore, the imposition of strong environmental controls in an area so conspicuously lacking in controls must be viewed favorably. Despite these desirable features, distortions in the intertemporal allocation of resources could result from the pressure that would be placed on prospectors to bring mines on stream at an early date.

A rational mining firm maximizing the present value of its profits would begin development of a deposit when the return earned on holding the undeveloped deposit just equalled the return available on alternative investments - that is, when the rate of increase in value of a deposit equals the market rate of interest. As Hotelling showed, the profit-maximizing activities of a competitive mining industry would maximize societal welfare. When a regulatory system is instituted which imposes penalties for delaying development,

the mining firms having development and production leases on marginally valuable deposits are forced to accelerate the timing of production if they want to avoid losing their rights under the lease. Such penalty provisions may indeed stimulate mining activity in the near future, but only at the cost of denying these minerals to future generations. The production incentives are undesirable because they would distort what are, in principle, decisions consistent with the maximization of social welfare.

CHAPTER 4

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CHAPTER 5

TAXATION AND TIMBER RESOURCE ALLOCATION

This chapter is divided into four sections. The first considers the nature of preferential taxation of forest property. The second section analyzes the impact of various forms of taxation on forest management decisions. The third section reviews the available evidence on industrial structure as it affects industry supply curves. The final section briefly treats some of the non-tax federal policies and regulations which affect the forest product industry supply curve.

I. FOREST PROPERTY TAXATION

As shown in Chapter 3, the income and property of the forest product industry is taxed preferentially, compared to general manufacturing. The principal tax subsidies to the forest product industry are capital gains treatment of profits from stumpage held for the requisite periods and reduced rates of property taxation.

Capital gains treatment of income derived from increases in the value of standing timber has been cited by Sunley, among others, as a form of preferential taxation of the forest product industry. As recapitulated in the historical review of Chapter 2, prior to 1944 the timber owners could obtain capital gains only when long term holdings of timber were sold while still standing. The extension of capital gains treatment to long term profits on appreciating corporate assets in 1942 created an inequity between corporations who processed their own timber and those who sold standing timber.[1] In 1944 Congress amended Section 117 of the Internal Revenue Code to rectify this inequity. At the time this amendment was being debated it was suggested that liberalizing the tax treatment of timber profits would stimulate the output of

forest products. Prior to 1942 neither group could obtain capital gains treatment; after 1942 only the latter group was entitled to take capital gains on long term stumpage profits.

Ordinary property taxes serve to shorten growing cycles and accelerate the rate of timber harvest. In addition, a system of uniform land and income taxes which did not discriminate by use or activity would lower private returns to forestry relative to other uses of the land and induce a conversion of forest land to other uses. The social benefits of forest land, which include the value of recreational opportunities and the like, may exceed private returns; therefore some form of public subsidization of forestry may be desirable if other uses of the land which yield lower social benefits are to be forestalled.[2,3,4] The subsidization of forestry through modification of the property tax takes a variety of forms, whose distribution among states is reported in Table 5-1.

Property tax treatment varies by locality and includes special treatment such as exemption and rebate laws, modified property tax laws, yield tax laws, and severance tax laws.

Exemption laws serve to remove forest lands and timber or timber alone from the property tax rolls for a term of years, or in certain instances, indefinitely. Most exemption laws require certain management techniques such as the planting of a particular variety of tree, the creation of snow or wind breaks, or the development of recreational opportunities for continued qualification under the law. Rebate laws allow the owner to apply for a reduction in his taxes in return for public benefits from the use of his lands. Exemption and rebate laws both suffer from complexity and unevenness of administration according to the Georgia Forest Research Council report.

Property tax laws for forest property have been revised by various states to lower the tax burden on timber (and agriculture) relative to other possible land uses. Modifications in property taxation procedures have included altering the assessment irrespective of other uses

Table 5-1. CLASSIFICATION OF FOREST TAX LAWS BY STATE AND TYPE OF LAW (as of 1973)

State	Exemption or Rebate	Modified Assessment	Modified Rate	Yield Tax	Severance Tax
Alabama	X	X		X	X
Arkansas		X	X		X
California	X	X			
Colorado	X				
Connecticut		X		X	
Florida		X			
Hawaii	X	X		X	
Idaho	X			X	
Indiana		X			
Iowa	X	X			
Louisiana				X	
Maine		X			
Maryland		X			
Massachusetts				X	
Michigan				X	
Minnesota			X	X	
Mississippi				X	
Missouri				X	
New Hampshire	X	X		X	
New Jersey	X	X			
New Mexico		X			X
New York				X	
North Carolina	X	X			
North Dakota			X		
Ohio			X		
Oregon		X		X	X
Pennsylvania		X			
Puerto Rico	X	X			
Rhode Island	X	X			
Tennessee	X	X			
Virginia					X
Washington		X		X	
West Virginia					X
Wisconsin			X	X	
TOTAL	12	23	5	19	6

Source: Timber Tax Journal, Vol. 10, p. 185.

which may be better in terms of maximizing land value, changing the rate from that applied to other property, and deferring payment until the timber is actually harvested.

The yield tax substitutes a tax at harvest for the annual property tax on timber. The property tax on land is often retained. The primary purpose of the yield tax is to aid forestry by eliminating the annual tax on timber.

Severance taxes, like yield taxes, are imposed when timber is harvested. Unlike yield taxes, severance taxes are imposed in addition to existing property taxes, and are used primarily as a source of additional revenues. Frequently the proceeds of a severance tax are devoted to State forest programs.

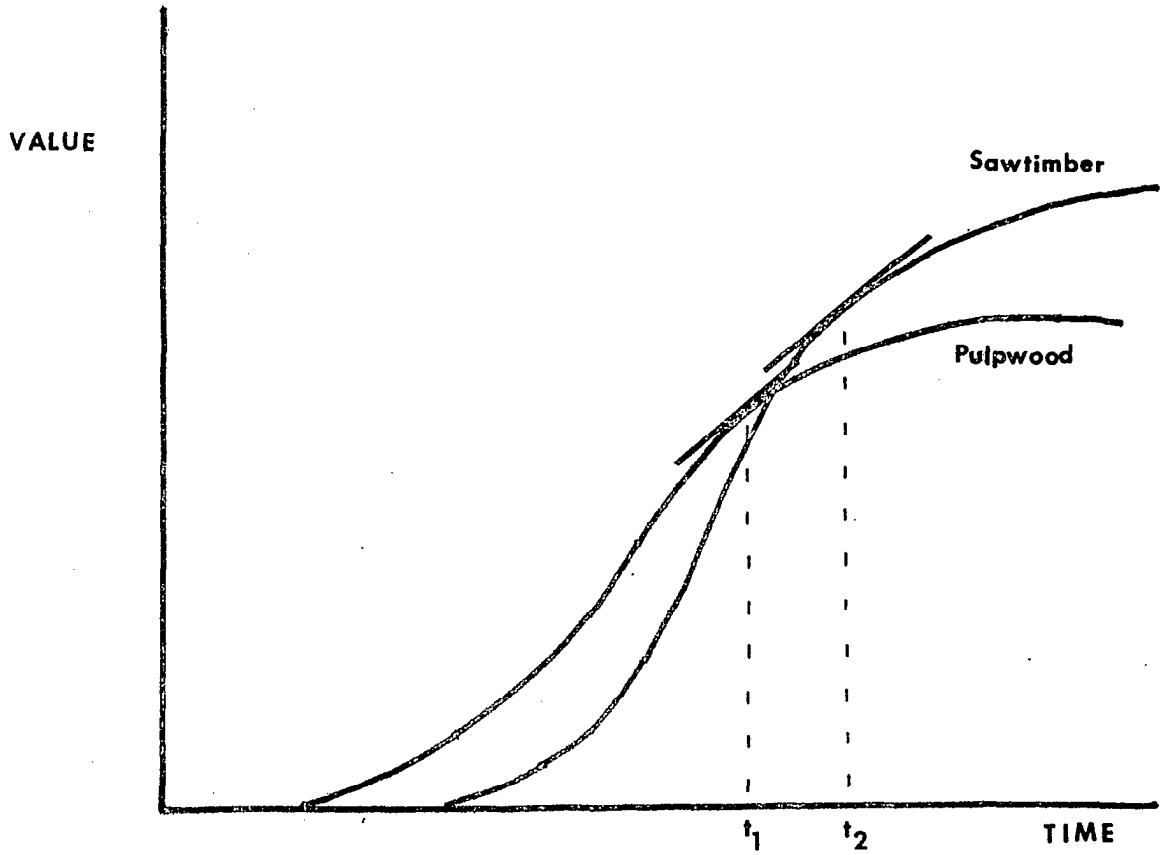
II. EFFECTS OF TAXATION ON FOREST MANAGEMENT DECISIONS

The determination of optimal (profit maximizing) growth periods for appreciating assets such as trees, liquor, and livestock has a long history in the economic literature.[5] Recently this work has been generalized by Thomson and Goldstein to include the effects of taxation.[6] Assuming a single harvest of a forest growing on a given plot of land, with lumber prices constant, one would wait until the gain from postponing the harvest one period equaled the interest foregone. This result may also be expressed as waiting until the rate of increase in value ceases to exceed the interest rate. The condition for profit maximization is depicted graphically in Figure 5-1. Profit maximizing growth periods for an infinite sequence of harvests, and for various forms of taxation of forestry, are considered later in this section.

The calculation of profit maximizing growth periods may result in ambiguity. There are two primary uses for the timber in most forests, pulpwood and sawtimber. These uses are not mutually exclusive in that the same logs that are used for pulp may also be used for sawtimber (and vice-

FIGURE 5-1

YIELD CURVES FOR PULPWOOD AND SAWTIMBER



versa). As Goundry[7] shows, the logistic curve of value for pulp logs normally crosses that for sawtimber. Figure 5-1 depicts this situation. According to the optimizing conditions there are two equally desirable dates of harvest, t_1 for pulpwood and t_2 for sawtimber.

The key to solving this apparent dilemma is to reconsider the criterion for optimization. The rule developed in the previous chapter is to maximize the net present value of the asset. Although calculus may well indicate two dates where both first and second order conditions are satisfied, in general only one can be the global optimum. At low interest rates sawtimber has the highest present value, but as interest rates rise the initial present value superiority of sawtimber gives way to the faster growth and shorter maturity of pulpwood. Thus the interest rate can be a crucial factor, not only in the determination of optimal harvest.date, but also in the type of wood grown.

The analysis can easily be generalized to include planting costs and an infinite cycle of harvests. Let:

V(t)	=	Present value of timber measured from the planting date
t	=	Number of years in the growth period
f(t)	=	Harvest value at time t
i	=	Discount or interest rate
P	=	Planting costs (incurred at t=0)

Present value is maximized when dV/dt = 0.

$$\frac{d(f(t)e^{-it} - P)}{dt} = f'(t)e^{-it} - if(t)e^{-it} = 0 \qquad (5)$$

Rearranging, one finds f'(t)/f(t) = i.

Planting costs have no effect on the optimal date of harvest in this model. The model may be too simplistic, however. It has been suggested that a variety of planting techniques are possible and that growth is affected by the choice of planting technique. This indicates that planting costs are properly included as an argument in the timber value function, in which case planting costs would affect the optimal date of harvest.

For an infinite series of harvests t years apart the present value of the harvest may be written

$$S = f(t)e^{-it} - P + f(t)e^{-2it} - Pe^{-it} + \ldots + f(t)e^{-nit} - Pe^{-(n-1)it} + \ldots \quad (6)$$

Recognizing that this is merely a geometric series, with initial term $f(t)e^{-it} - P$ and common ratio e^{-it}, the sum may be written as:

$$S = \frac{f(t)e^{-it} - P}{1 - e^{-it}} \quad (7)$$

$$S = \frac{f(t) - Pe^{it}}{e^{it} - 1} \quad (8)$$

Maximizing with respect to t provides the result that trees should be cut when:

$$\frac{f'(t)}{f(t)} = i\frac{1 - P/f(t)}{1 - e^{-it}} < i \quad (9)$$

That is, the optimal harvest date is earlier than in the one cycle case, so long as e^{-it} exceeds the ratio of planting costs to harvest value. Mow e^{-it} will approach zero for large values of t, while planting costs should be but a small portion of the harvest value, assuring the shortening of harvest cycles.

Forest industry taxation induces adjustments in growing and harvesting cycles by altering the profit maximizing conditions. Thomson and Gold-

stein (page 32) demonstrate that the effect of the severance tax is to lengthen the optimal growth period, while their specification indicates that income and capital gains taxes are neutral with respect to growth periods. They do not explicitly analyze the effect of the property tax - either in the above form or in its various deferred applications.

The property tax formulation based on value of the timber stand is not readily amenable to analysis. An alternative formulation which assumes taxes are uniform at amount T per year may be readily solved.

$$\frac{f'(t)}{f(t)} = i\left[\frac{1 - P/f(t)}{1 - e^{-it}}\right] + \frac{\frac{t}{if(t)}\left[1 + e^{-it}\right]}{1 - e^{-it}} \qquad (10)$$

Because the second term on the right hand side of this expression is always positive, the rate of increase in value, f'(t)/f(t), is larger than it was in the absence of taxation. A property tax which is constant through time serves to shorten the growing period, resulting in premature harvests.

Unfortunately the Thomson-Goldstein analysis fails to recognize a more subtle impact of taxation on optimal (profit maximizing) harvest dates, and consequently their results may not be valid. Consider, for example, the income tax. The work of **Mieszkowski**[8] and **Harberger**[9] demonstrated that under some very general assumptions an income tax is largely a tax on capital, and hence would serve to alter relative factor prices in the production of timber. The Thomson-Goldstein production function contains time as its only argument, but surely a general formulation would include both capital and labor as well. Taxation of capital in forestry at a rate below that in general manufacturing (through capital gains treatment of increases in stumpage value) would serve to lower the cost of capital in forestry relative to other industries. Because capital-labor substitution in forestry is unknown, one can only speculate on the results. It appears that more of the relatively cheap capital (land) will be used and less effort will be devoted to labor intensive

activities like thinning and spraying. This effect through capital-labor substitution would tend to slow growth rates, lengthen the profit maximizing growth period, and thus reduce the supply of timber. At the same time, of course, a lower tax rate on timber ownership will affect land use decisions at the margin. The lower is the rate of taxation of timber profits, the more land that will be devoted to timber growing. The net effect between the two countervailing forces (more timber land, but each acre producing less) is ambiguous without a more rigorous treatment of this problem.

Recently, Hartman[10] extended the modeling of optimal harvesting decisions to include non-timber values. Specifically, he considered the case where a standing forest provides flood control, recreational, or other services. The conditions for optimality, which are derived analogously to the equations 5 through 9, indicate that the forest should be harvested when the flow of non-timber benefits plus the growth in forest value ceases to exceed the interest foregone. If non-timber benefits are large relative to the value of the standing timber, this indicates that the harvest should be postponed, perhaps indefinitely. Hartman did not analyze the structure of taxes which would be necessary to internalize this externality.

III. INDUSTRIAL STRUCTURE

The forest product industry may be divided into two broad categories: smaller timber owners and diversified corporations active in all phases of the industry. Among diversified forest product corporations Fortune has long distinguished between paper companies and integrated forest product companies, but such a distinction may be unwarranted. Nearly all of the paper companies are significant factors in the production of lumber, plywood, and chemicals, while most of the firms classified as diversified forest product concerns produce large volumes of pulp and paper from wood residues. In addition, there are a number of smaller

firms that specialize in a narrower segment of the industry. Some such as Bohemia and Pope & Talbot engage primarily in the cutting of timber on public lands. Others such as Fort Howard Paper, Garden State Paper, Alton Box Board, Fiberboard, and Federal Paper Board, use as primary inputs wastepaper generated from post consumer and industrial conversion waste.

Capital intensity in production is highest for the large diversified firms and least for the scrap users. According to Fortune, assets per employee for four of the diversified firms including Weyerhaeuser, Georgia Pacific, Boise Cascade, and Potlach Forests averaged over $49,000 in 1973. For a group of nine paper companies, capital per worker averaged $41,700, while for the firms using wastepaper it averaged $32,700. This compares with the average for all manufacturing of under $30,000.

According to computations by Fortune, the rates of return to equity invested in the wood product industry have been below the average for the 500 largest manufacturing concerns .for most of the last decade. When rates of return are separated into those classified by Fortune as paper companies and those classified as large diversified forest product companies, a significant difference emerges. The large forest product companies have consistently earned higher than average returns (with the exception of Boise Cascade whose ill fated venture into real estate caused large losses in 1971 and 1972), while the paper companies have experienced excess capacity and low rates of return throughout the 1960's and into the early 1970's. Recently demand has caught up with capacity and rates of return to paper companies are improving. Table 5-2 presents some of this data.

In searching for an explanation of the difference in rates of return for these two groups, it should be asked if the difference is real or merely the result of some form of measurement error. One likely explana-

Table 5-2. RATES OF RETURN TO EQUITY IN PAPER AND FOREST PRODUCTS INDUSTRY

International	Mead	Crown Zellerbach	St. Regis	Kimberly Clark	Scott	Weyerhaeuser	Georgia Pacific	Diamond International	Fortune's Paper & Wood Prod. Ave.	500 Industrial Average	YEAR
3.7	7.9	10.0	6.4	9.4	12.3	11.5	13.4	13.0			1964
9.1	8.6	9.9	8.2	8.9	12.7	13.2	12.4	15.3			1965
10.3	9.8	10.7	8.4	9.4	11.4	12.0	12.4	16.0		12.7	1966
8.4	6.9	9.6	6.4	9.9	10.2	9.1	11.8	14.7	9.0	11.3	1967
9.2	7.5	11.0	7.0	9.2	10.8	14.7	13.8	14.2	10.0	11.7	1968
10.3	8.0	9.6	7.8	7.2	11.5	13.9	14.7	13.9	10.5	11.3	1969
7.5	4.5	7.4	6.7	8.4	9.1	12.2	11.8	12.9	6.8	9.5	1970
5.0	5.2	5.3	3.4	-	5.1	9.6	12.0	12.6	5.6	9.1	1971
9.2	4.0	6.0	7.6	13.7	7.1	14.1	15.9	12.5	8.6	10.3	1972
13.5	10.8	15.6	10.5	13.4	9.8	25.1	21.0	14.0	13.5	12.4	1973

Source: Fortune, various issues, and corporation annual reports.

tion, noted in an earlier chapter, is that land used for production of timber is presently worth substantially more than its book value. Land at its original acquisition cost is included in the asset base for rate of return calculations. If land values are adjusted to reflect current market prices, the high rate of return for the forest product companies, as compared with general manufacturing, would probably disappear. Another possible explanation for the difference between the two groups is that those classified as integrated concerns utilize wood more fully. Given large transportation costs in proportion to product value, it is likely that non-integrated concerns are offered low or zero prices for wood residues and scraps. Users of the residues are able to obtain inputs more cheaply from nearby sources.

IV. THE EFFECTS OF NON-TAX FEDERAL POLICIES ON TIMBER SUPPLY

This section reviews certain non-tax federal timber policies as they affect the supply of stumpage from public lands. Federal lands supply a relatively small portion of total stumpage, because they constitute a small percentage of total acreage (Table 5-3) and the federal lands are relatively low in productivity (Table 5-4).

Retention of lands of particular national importance in federal ownership began with the legislation creating Yellowstone National Park in 1872[11]. The growing interest in conservation in that era produced at least two significant pieces of legislation that have profoundly affected domestic forest policy, the Forest Reserve Act of 1891[12] and the Forest Service Organic Administration Act of 1897.[13] Presidents Harrison, Cleveland, McKinley and Roosevelt utilized the executive authority conferred by the 1891 Act to withdraw millions of acres of public timber lands from disposal under earlier statutes. The Forest Service Organic Administration Act of 1897 provided the basis for the establishment of the present system of national forests which now encompass some 187 million acres, 91 million of which are forested, in 155 national forests in 40 states.

Table 5-3 OWNERSHIP OF COMMERCIAL TIMBERLAND

Type of Ownership	Total United States Area	Proportion	North	South	Rocky Mts.	Pacific Coast
	Thousand Acres	Percent	Thousand Acres	Thousand Acres	Thousand Acres	Thousand Acres
Federal:						
National Forest	91,924	18	10,458	10,764	39,787	30,915
Bureau of Land Management	4,762	1	7 5	11	2,024	2,652
Bureau of Indian Affairs	5,888	1	815	220	2,809	2,044
Other Federal	4,534	1	963	3,282	78	211
Total Federal	107,109	1	12,311	14,277	44,699	35,822
State	21,423	4	13,076	2,321	2,198	3,828
County and municipal	7,589	2	6,525	681	71	312
Forest industry	67,341	14	17,563	35,325	2,234	12,219
Farm	131,135	26	51,017	65,137	8,379	6,602
Miscellaneous private	165,101	33	77,409	74,801	4,051	8,840
All ownerships	499,697	100	177,901	192,542	61,632	67,622

Source: U.S.D.A., The Outlook for Timber in the United States, FRR-20, July 1974.

TABLE 5-4. AREA OF COMMERCIAL FOREST LAND BY OWNERSHIP CLASSES AND SITE QUALITY (Areas in Million-Acres by Site Classes)[a]

Ownership class	I	II	III	IV	V	All site classes
National forest	2.9	8.5	17.6	32.7	25.2	86.9[b]
Other public	2.0	3.5	6.0	16.7	16.0	44.2
Forest industry	4.1	8.0	18.8	24.9	11.5	67.3
Other private	4.4	18.0	73.8	121.2	78.8	296.2
All ownerships	13.4	38.0	116.2	195.5	131.5	494.6

a Site class I to V refer respectively to lands capable of producing growth of 165-plus, 120-165, 85-120, 50-85, and 20-50 cubic feet of timber per acre per year.
b Estimates of area subclasses do not include 5.0 million acres of national forest lands in the Rocky Mountain States that are not included in the base for allowable cut because of such factors as unstable soils, small size of isolated patches and stringer, or special use constraints. Volume and growth data are also excluded for these areas.

Source: U.S.D.A., The Outlook for Timber in the United States, FRR-20, July 1974.

Unappropriated and unreserved lands of the United States are administered by the Bureau of Land Management of the Department of the Interior and total some 470 million acres principally in the eleven western states and Alaska. Following its creation[14] in 1946 from a merger of the old General Land Office and the Grazing Office, the Bureau of Land Management obtained a clearly defined mandate from Congress in the Classification and Multiple-Use Act of 1964[15] which provided for multiple use objectives similar to those of the Forest Service Organic Administration Act, and the later Multiple-Use and Sustained-Yield Act of 1960[16] which directly affects Forest Service harvesting policy.

Land held by various state and local agencies was primarily obtained by confiscation for non-payment of property taxes during the 1930's. There does not appear to be any explicit policy directing land use decisions on most of this acreage, although some states (especially Washington) have discovered state-owned forest lands as a source of revenue and manage forest lands well.

That private timber holdings, especially those under control of the forest industry, dominate other categories in importance as a source of supply, becomes abundantly clear when one considers the ownership and productivity of the various forest lands. Commercial timber land is defined by the U.S. Department of Agriculture to be land capable of yielding 20 or more cubic feet of new growth per acre per year. According to a recent study a large portion of the best sites yielding in excess of 85 cubic feet per acre per year are in forest industry ownership, while holdings by public agencies in national forests and elsewhere have a high proportion of sites with the potential for less than 50 cubic feet per acre per year.[17]

It has always been the avowed policy of the Forest Service to permit a wide variety of compatible uses in the national forests. This policy

was formalized in the Multiple-Use and Sustained-Yield Act of 1960. This Act does not specify any priorities among competing uses, leaving the determination of appropriate use to be decided on a case by case basis. Before considering the complications that arise when one considers multiple use, it is convenient to examine public policy and private decision making regarding the choice of harvesting technique of public lands.

Although timber is frequently cited as one area where astute practices on both the governmental and private level have led to an increase in the resource base, while simultaneously satisfying demands for current use of the resource, there is a sharp divergence of opinion as to whether or not we have enough timber for the future. The relative uncertainty of timber inventories held by the industry, and additional uncertainties associated with estimates of future growth rates following various harvesting practices, combine to make forecasting difficult. In a recent report the Forest Service argues that demands are indeed growing more rapidly than forests can be regenerated, and that unless prices for forest products rise rapidly in the near-future severe shortages are to be expected. (See The Outlook for Timber in the United States. Forest Resource Report No. 20.) The balance between removals and new growth is presented in Table 5-5. It indicates that for 1970, removals were comfortably surpassed by growth for all species except softwoods in the Pacific Coast. In this area a special consideration prevails in that much of the forest has never been harvested. Under more intensive harvesting and management it is thought that its yield could be substantially increased.

When the balance between growth and removal is considered for the category of dimension lumber (sawtimber), the optimistic pattern starts to fade. Historically, removals mainly consisted of mature trees, for relatively large trees were required for dimension sawing. Growth predominates in smaller trees, which are not cataloged as sawtimber until they reach a diameter of 11 inches. The Forest Service has argued that at present

Table 5-5. NET ANNUAL GROWTH AND REMOVALS OF GROWING STOCK, BY SPECIES GROUP AND SECTION[a]
(Billion Cubic Feet)

Section	All species			Softwoods			Hardwoods		
	1952	1962	1970	1952	1962	1970	1952	1962	1970
North:									
Net growth	4.1	4.9	5.5	1.1	1.2	1.4	3.0	3.6	4.2
Removal	2.1	2.5	2.4	.6	.6	.6	1.5	1.5	1.8
Ratio of growth to removals	2.0	2.5	2.3	1.7	2.2	2.2	2.1	2.4	2.3
South:									
Net growth	6.3	7.5	8.6	3.6	4.5	5.4	2.7	3.0	3.2
Removals	5.7	5.4	6.5	3.1	2.8	4.0	2.6	2.6	2.5
Ratio of growth to removals	1.1	1.4	1.3	1.2	1.6	1.4	1.1	1.1	1.3
Rocky Mountains:									
Net growth	1.2	1.3	1.4	1.1	1.2	1.3	.1	.1	.1
Removals	.5	.7	.0	.5	.7	.9	b	b	b
Ratio of growth to removals	2.2	1.8	1.5	2.1	1.7	1.4	21.9	18.9	26.2
Pacific Coast:									
Net growth	2.3	2.7	3.1	2.0	2.3	2.6	.3	4	.5
Removals	3.5	3.6	4.2	3.5	3.5	4.1	b	.1	.1
Ratio of growth to removals	.7	.8	.7	.6	.7	.6	6.7	4.9	4.1
Total, United States:									
Net growth	13.9	16.4	18.6	7.8	9.3	10.7	6.1	7.1	7.9
Removals	11.8	11.8	14.0	7.8	7.6	9.6	4.1	4.2	4.4
Ratio of growth to removals	1.2	1.4	1.3	1.0	1.2	1.1	1.5	1.7	1.8

a Data may not add to totals because of rounding.
b Less than 1 billion.

Source: U.S.D.A., The Outlook for Timber in the United States, FRR-20, July 1974.

removals exceed growth in the Rocky Mountain and Pacific Coast Regions, and for the nation as a whole. The forest industry has countered this evidence with the observation. that "the Forest Service has been predicting a shortage ever since it began, and it hasn't happened yet."[18] They also feel that because trees as small as 4 inches in diameter are currently being used for dimension sawing, the Forest Service inventory of growth is biased downwards. Under more intensive management, including shorter growth cycles, the industry anticipates significant supply increases not forecast by the Forest Service.

Even if corporate projections of substantial increases in timber supply from lands held by the forest products industry are achieved, the total future supply of timber may change but little due to court imposed restrictions on harvesting techniques in National Forests. In the decision, West Virginia Division of the Izaak Walton League v. Butz, the Fourth Circuit Court of Appeals upheld a lower court ruling that the Organic Act of 1897 (16 U.S.C. §§ 473-482, 551) bans clearcutting on federally owned land in the Monongahela National Forest. Of the four principal systems of harvesting timber (the clearcut, seed tree, shelterwood, and selection systems), clearcutting is considered by the timber industry to be the least costly, and most beneficial to the establishment of a new crop. At the same time clearcutting also results in the most radical alteration in the forest environment.[19]

Should the decision in the Monongahela National Forest be extended by other courts to cover the remaining national forests, the costs of obtaining timber from public lands will rise substantially. This would have the effect of reducing the public lands component of the timber industry supply curve.

CHAPTER 5

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CHAPTER 6

THE EFFECTS OF TAXATION ON VIRGIN MATERIAL PRICES

This chapter examines the impact of a variety of taxes and tax subsidies on the price of virgin material outputs. The price impacts are computed for the virgin material product which competes most closely with scrap materials as an input to further production processes. For example, scrap steel is most often viewed as a substitute for pig iron in many steel manufacturing processes. Consequently, the impact of corporate taxation on the price of pig iron, rather than other iron-based products, will be of most interest to us here.

Part one of this chapter examines the impact of net and gross income taxes, as well as expensing provisions for mineral exploration and development and severance taxes on the supply schedule for virgin material outputs. In part two the impacts of various taxes on the price of semi-manufactured virgin based products (such as pig iron) are computed. It begins with a discussion of the assumptions underlying the calculation of price effects and continues with specific analyses of the paper, steel, copper, lead, and aluminum industries.

I. THEORIES OF TAX INDUCED SHIFTS IN SUPPLY

A. Income Taxation

It is generally agreed that a tax on the profits of a monopoly leaves unaffected the position of the short run marginal revenue and marginal cost schedules. Hence a tax on profits does not change the position of profit maximizing output. Only if a monopolist was not previously maximizing profits would one expect to observe a short run price increase. In the long run a tax on profits could in effect become tax on capital (if at least a normal return was not being earned). This would change marginal cost and hence profit maximizing output.

A tax on the economic profits (profit after allowing for all costs including normal return to capital) of pure competition would produce no revenue, because there are no economic profits associated with pure competition. AS such it would have no effect on price or quantity. But the corporate income tax is levied not only on economic profit, but also on the normal return to capital. As Robertson[1] and others have argued, the normal profit component is included in the cost schedule of a firm and thus a tax on normal profits is a tax on cost. If the tax is on all capital the supply of capital may be curtailed. If the tax is partial and affects only a few firms or industries, firms will leave the industry subject to taxation and move into fields not subject to taxation until returns net of tax are equalized.

Harberger[2] and Mieszkowski[3] have argued that, under some very general assumptions, an income tax is born by the single factor of production, capital. The extent to which a tax on one factor will induce substitution among inputs depends on the elasticity of substitution - the percentage of change in the ratio of factor use in response to a one percent change in the ratio of factor prices. Several studies have attempted to estimate elasticities of substitution for different industries, but the reported results for individual industry classifications exhibit extreme variation. (For example, Blair and Kraft[4] estimated the

elasticity of substitution for lumber to be 1.3 and for iron and steel foundries .50. Unfortunately, their report does not contain estimates for the industrial classifications discussed in this report.) Estimation of the impact of income taxes on the industry supply curve depends critically upon knowledge of the elasticity of substitution, and until better estimates are developed further progress along these lines is virtually impossible.

If one is willing to assume the magnitude of the elasticity of substitution, it is possible to estimate the impact of income taxation on supply. Consider for example the unitary elasticity of substitution as embodied in the Cobb-Douglas production function. The supply curve (marginal cost curve) for a firm in pure competition can be derived from (1) the production function, (2) the cost equation, and (3) the expansion path. It can be shown that marginal cost for a 'given level of output depends on the cost of capital raised to the power'b', where 'b' is capital's share in the output.*

A further complication encountered in attempting to trace the impact of a change in income tax rates on the industry supply curve results from the unpredictable manner in which income taxation affects the cost of capital. Income taxes are levied on accounting profits - which are merely the return to equity capital. Tax liability for the return on borrowed capital is reduced by the amount of the interest paid on the borrowed capital. A change in the rate at which the return on equity

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* From (1) $Q = L^a K^b$
(2) $C = wL + rK$
(3) $\frac{wL}{a} = \frac{rK}{b}$

it is easy to show that $C = r^b Q(a/bw)^{-a}$, provided constant returns to scale, or a + b = 1. Marginal cost is given by:

$$\frac{dC}{dQ} = MC = Ar^b$$

where A = the constant $(a/bw)^{-a}$

capital is taxes induces a substitution between debt and equity that is difficult to predict, hinging as it does on attitudes toward financial riskiness of the capital structure.

The inability to predict factor substitution in response to shifts in relative factor prices precludes accurate analysis of marginal costs of production when income tax rates are changed. Though precise derivations are impossible, one can compute the maximum possible impact, which is obtained when the elasticity of substitution is zero. For this situation, a change in relative factor prices induces no changes in factor proportions. This assumption overstates the impact on cost when the price of a single factor is increased (because of substitution which ordinarily would occur toward the factor whose price remained fixed), but understates the impact when the price of one factor is reduced (because even more would be used as substitution toward that factor takes place). Later in this chapter we develop estimates of the impact of capital gains taxation on the supply curve for virgin woodpulp based on the assumption of zero elasticity of substitution of capital for labor. These estimates are based on what would happen to the existing supply curve, which reflects capital gains treatment of stumpage profits, should capital gains be disallowed in the future. As noted, this will overstate the upward shift in the supply curve to the extent there is substitution among inputs.

B. Taxes on Gross Income

Two special tax provisions for mineral industries are based on gross income; percentage depletion and severance taxes. The depletion allowance serves to exempt from income taxation a percentage of gross revenues. As such it serves as a subsidy in the amount of the tax that would have been paid on this income. Severance taxes are typically levied by states and are set as a percentage of the value of output. Taxes that are based on the value of output are termed ad valorem taxes (or subsidies in the case of percent depletion).

The algebraic equivalence between severance taxes (or excise taxes) and a depletion allowance can be demonstrated.

Let R = Revenue

c = cost

t = Income tax rate

s - Severance tax rate

d - Rate of percent depletion

After-tax profits with severance taxes (1-t)(R-C-sR), equal after-tax profits with a depletion allowance, R-C-t(R-C-dR) when the 50 percent of net income limitation requires that $dR \leq (R-C)/2$..

The adjustments of competitive and monopolistic industries to ad valorem taxes and subsidies are depicted in Figure 6-1, panels A and B. The competitive industry supply schedule before the imposition of an ad valorem tax is S-S; it intersects the market demand curve to produce an equilibrium price of P_o. A tax of T per dollar raises the supply curve to S'-S', and the corresponding market price is P'. The relationship between the change in price and the tax is: $\Delta P = TE_s/(E_s + E_d)$,* where E_s and E_d refer to the elasticities of supply and demand respectively.

The monopolistic ease is depicted in Panel B.. Here an ad valorem tax of T per dollar shifts marginal cost from MC to MC' and market price from P to P'. The change in market price can be estimated if one knows both the slope and intercept of the demand curve (from which the marginal revenue can be determined) as well as the marginal cost curve for the firm. Inasmuch as none of the industries studied are organized as monopolies, further analysis of this model will not be developed.

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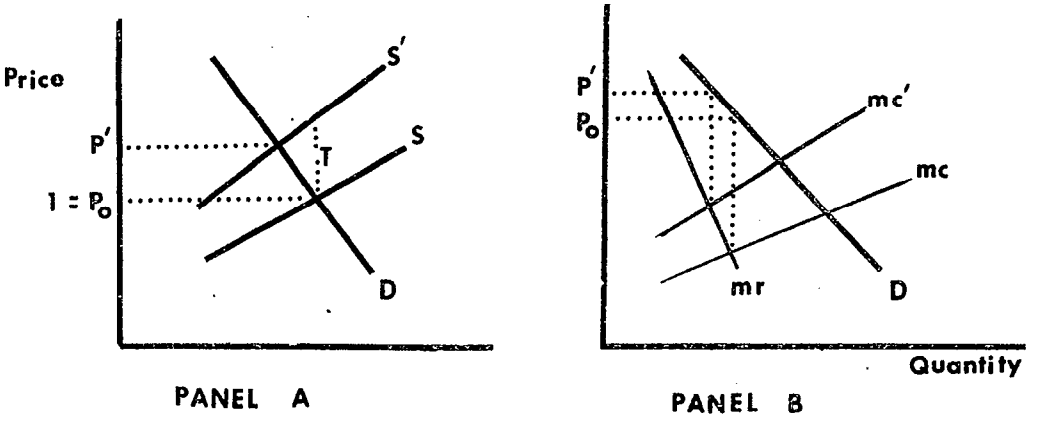
* Let D_1 represent the slope of the demand curve and S_1 represent the slope of supply. Then $\Delta P = \Delta Q$, where ΔQ is the reduction in quantity as a result of the tax. Similarly we may calculate $\Delta P = T(D_1 \Delta Q)/(D_1 \Delta Q + S_1 \Delta Q)$, since T is just $D_1 \Delta Q + S_1 \Delta Q$. Substituting $E_d \equiv (P/Q)D_1$ and $E_s = (P/Q)S_1$ we obtain the above result.

Figure 6-1. EFFECTS OF AD VALOREM TAXES ON MARKET PRICE



As noted earlier a depletion allowance is equivalent to a negative excise tax, provided the 50 percent of net income limitation has not been exceeded. This means that if the portion of market price attributable to the allowance, (T/P'), can be determined the percentage change in market price which results from elimination of the allowance is obtained directly as:

$$\frac{\Delta P}{P'} = \frac{(T/P')\ E_s}{E_s + E_d}$$

The impact of the percent depletion allowance on the supply of domestic mineral output deserves a more careful scrutiny. As noted in Chapter 2, depletion deductions are limited to half of net income from an operating unit. This in turn means that there will be, in general, two different effects depending on the profitability of an operating unit. For those units which are not constrained by the 50 percent of net income limit, profit margins on sales are in excess of twice the rate of percent depletion. One would expect that when profit margins are this high production has already been pushed about as far as possible and the depletion deduction would make little difference on output.

As Miller has noted, percent depletion should affect the profitability

and hence output decisions for marginal operating units which are constrained by the 50 percent of net income limit. Because production costs are only slightly below output price, a change in the income tax rate would have a significant influence on output decisions for many of these units. With the corporate income tax rate at 48 percent, the effective income tax rate on investment in marginal production is 24 percent (half of income is sheltered from taxation). This indicates that the required pre-tax rate of return has been reduced from approximately 14.8 percent (the average for 1969) to 10.1 percent for the marginal mining operations, so that the marginal mining units would offer 7.7 percent after taxes, the average for all corporations (in 1969).

Assuming a capital-output ratio of about 2.0 in metal mining, the supply curve for metals would be shifted downward by approximately 9.4 percent by percent depletion. (14.8 percent - 10.1 percent = 4.7 percent of capital costs, which are then multiplied by the capital-output ratio of 2.0 to obtain the 9.4 percent impact on the supply curve of the marginal producers.)

C. Expensing of Exploration and Development

The income tax provisions under which mining firms may treat as a current expense non-depreciable exploration outlays designed or intended to locate and define the extent of mineral properties were discussed in Chapter 2. In many respects this deduction is remarkably similar to one not only allowed, but now mandated by generally accepted accounting principles, for manufacturing concerns which engage in research and development. Outlays for research and development are expensed as incurred, resulting in an immediate reduction in tax liabilities, even though the research is likely to enhance the long run value of the firm. The deduction is subject to recapture in the future to the extent that profitable discoveries evolve from the research program.

At the election of the taxpayer mineral exploration for the purpose

of "ascertaining the existence, location, extent, or quality of any deposit" may be deducted against current income or added to the adjusted basis of the mineral sites.[5] In practice, expensing of exploration is normally far more favorable in tax impact than is capitalization - principally because percent depletion would be lost as an option should the firm assess exploration outlays to the cost, or adjusted, basis and recover them through cost depletion. If any mine for which exploration outlays were previously expensed reaches the producing stage, the deductions are recaptured through reductions in depletion deductions that may be taken, or through the addition of the outlays to taxable income.

Tax treatment of exploration expenditures which are added to the adjusted bases and recovered through cost depletion is remarkably similar to the treatment of investment in plant and equipment, the closest counterpart in manufacturing. In manufacturing a firm recovers investment outlays gradually through depreciation deductions against taxable income.

The tax treatment of exploration which is expensed and later recaptured has the counterpart of successful research endeavors in manufacturing. Outlays which are expensed and later recaptured result in no net deduction, but do alter the timing of tax payments. In contrast, outlays which are added to the adjusted basis and then recovered through cost depletion do result in a net deduction, but the timing is not so favorable. In principle, a mining firm must choose between a substantially improved timing of tax payments with no net reduction in taxes, and a net reduction in taxes - but only in future years. This simplistic view requires one major modification. A firm electing to take cost depletion on a property may not simultaneously obtain the benefits of percent depletion. Because percent depletion is normally so favorable in impact, firms probably are induced to expense more than they would like, and capitalize less than they would like, just to be able to utilize the percentage depletion deduction.

Development expenditures incurred after the existence of ores or minerals in commercially marketable quantities has been ascertained may be deducted from taxable income in the year in which they occur. Alternatively, development expenditures may be deferred for deduction against income in future years. The deferral of development deductions is rational corporate policy when income would otherwise be reduced to the extent that percent depletion deductions would be constrained by the 50 percent of net income limitation.

The tax treatment of development expenditures has no counterpart in manufacturing. It is much as if investments in plant and equipment could be depreciated within one year - the tunnels and shafts in mining corresponding to buildings in manufacturing.

The Treasury Depletion Survey of 1958-1960 provides the only comprehensive data on tax treatment of development expenditures. It is apparent from Table 6-1 that most development expenditures are immediately expensed - but a considerable fraction is also deferred. Only for lead and zinc are the quantities capitalized significant.

Table 6-1. DEVELOPMENT EXPENDITURES 1960
(Percentage Distribution by Tax Treatment)

Mineral Product	Deducted as Current Expense	Charged as Deferred Expense	Charged to Depletable Asset Account	Charged to Depreciable Asset Account
Bauxite	100.	-	-	-
Lead & Zinc	43.2	10.4	9.8	36.7
Iron	99.8	-	-	.2
Copper	62.9	36.7	-	.4
Limestone	51.9	40.4	7.5	.2
Anthracite	92.7	7.3	-	-

Source: President's 1963 Tax Message

The Treasury Survey also allows direct comparison of current deductions for exploration and development with the magnitude of the depletion subsidy (depletion taken in excess of actual cost depletion).

Table 6-2. DEDUCTIONS FOR EXPLORATION AND DEVELOPMENT

Mineral	Percent of Depletion in Excess of Cost Depletion
Metal Mining	41%
Primary Metal Manufacturing	49%
Bituminous Coal	28%
Stone, Clay and Glass	14%

Source: President's 1963 Tax Message

An attempt to update the 1960 Treasury Survey to obtain figures on expensing for 1973 failed because corporations are not, under present SEC regulations, required to report any class of expenditure aggregating less than 1% of sales revenue. Those firms reporting mineral exploration outlays separately are listed in Table 6-3 along with depletion and exploration amounts as a percent of pre-tax income. For this sample exploration is about one-third of depletion.

Table 6-3. MINERAL EXPLORATION OUTLAYS

Firm	Depletion as Percent of Pre-Tax Income	Exploration as Percent of Pre-Tax Income
Bethlehem Steel		
1973	7.3	2.3
St. Joe Minerals		
1973	20.8	7.1
1974	22.9	3.8
Phelps Dodge		
1973	18.8	4.9

Source: Derived from Corporation 10-K Reports

D. Severance Taxes

Severance taxes on mineral output are levied by many states. Functioning directly as excise taxes, the severance taxes serve to reduce the favorable impact of percent depletion. Some severance taxes are levied on unit weight, others are based on the value of output at the mine, and still others are based on the value at a higher stage of processing, or on gross income. Such variation makes generalization of the impacts difficult.

Only two of the mining firms in the survey of Chapter 3 reported state severance taxes separately from other taxes. For Kennecott Copper severance taxes in the amount of $14.44 million in 1973 amounted to 22 percent of the reduction in income taxes attributable to percent depletion. For AMAX state severance taxes of $4.17 million were 20 percent of the reduction in income taxes attributable to percent depletion.

Some examples of state severance taxes- are:

Idaho	2% of value of ores mined
Kentucky	4% of value of coal mined
Minnesota	15 1/2% of value of iron ore mined
	15% of value of taconites mined
Arkansas	15 cents per ton of bauxite mined

Bauxite mined in Arkansas was worth about $14.00 per ton making the severance tax slightly over one percent of value. The percent depletion allowance, by way of comparison, excluded 22 percent of value from taxation at the rate of 48 percents, and represented a negative excise tax of .48 X 22 percent = 10.6 percent - or about ten times the amount of the severance tax.

II. ANALYTICAL MODELS OF TAXATION AND RESOURCE USE

The analysis of tax induced shifts in the supply curve for virgin material inputs theoretically would involve the comparison of market equilibria, before and after the tax change, in the product market as well as in the factor markets for virgin and scrap inputs. The relationships may be depicted as follows:

Product Market	Demand = F_1 (Price of Output, Income, Other Prices)
	Supply = F_2 (Price of Virgin Input, Price of Scrap Input, Prices of Other Inputs).
Virgin Input	Demand = F_3 (Price of Output, Price of Virgin Input, Price of Scrap Input)
	Supply = F_4 (Virgin Availability, Processing Costs)
Scrap Input	Demand = F_5 (Price of Output, Price of Scrap Input, Price of Virgin Input)
	Supply = F_6 (Scrap Availability, Processing Costs)

A change in taxation of virgin extractive industries would shift the virgin input supply curve. The accompanying change in virgin input prices would shift the supply curves in both the scrap input market and in the market for final outputs. Prices for final output and scrap inputs would change, and these changes in turn would induce a second round of adjustments in the virgin input market. The ultimate equilibrium situation in virgin and scrap input markets is only approximated by the first round of adjustments. Because the tax changes considered later will typically involve removal of a subsidy - thereby shifting virgin input supplies upward - the supply for final outputs will

also be shifted upward. A lower production of final outputs will ensue and tend to lower the demand for both scrap and virgin inputs - and thus the equilibrium impact on virgin input prices normally will be less than that indicated in the first round of changes. Similarly the demand for scrap-should rise somewhat less than predicted by estimated cross elasticities multiplied by the first order effects in virgin input prices, both because less final output is being sold and because the change in virgin input prices was over-estimated.

In the remainder of this section the magnitude of the shift in the supply curve for virgin materials is analyzed. Removal of tax benefits which affect the cost of a single factor of production would be expected to elicit substitution among inputs, but in the analysis to follow such substitution is assumed to be negligible. Consequently, the estimated supply curve shift for pulpwood, should capital gains be denied in the growing and harvesting of timber, may be biased upward. For tax benefits which affect gross income, such as the depletion allowance and severance taxes, substitution among factor inputs would also be expected to lower the shift in supply from that computed here.

A. Paper

Standing timber, or stumpage, is harvested, converted to wood chips, and dissolved into woodpulp, before manufacture into paper products. Wastepaper, the scrap industry's input to the production of paper products, is processed and converted to a pulp before manufacture into paper products. Wastepaper probably substitutes most directly for virgin market pulp as an input, though the technical relationships are quite complicated (See the section on paper in Chapter 9).

The maximum impact of capital gains taxation on the price of virgin market pulp is obtained under the assumptions that stumpage costs are negligible so that all of stumpage price is profit, and the supply curve for stumpage is elastic so that taxes on inputs are passed forward onto

product price rather than backward onto land rents. The cost of acquiring stumpage may be negligible for timber owners who wait for seedlings to mature - especially since many of the costs of timber management are deductible against current income. An elastic supply of land for the production of timber implies that a tax imposed on the growing of timber will cause changes in land use until timber is once again as profitable as other competing uses. That is, the supply curve for stumpage will shift vertically by the amount of the tax.

It should be noted that the maximum impacts of changes in timber tax policy are achieved only when sufficient time has elapsed to attain equilibrium. Though land values would be expected to reflect changes in tax policy almost immediately, the impact of taxation on timber supply would be very gradual. For example, the 1944 extension of capital gains treatment to long term profits on stumpage processed by integrated timber firms certainly made the growing of timber more attractive relative to alternative uses for many lands. This would be reflected in an enhancement in the value of those lands for which timber became the most valuable crop as a result of the change in the tax code. Though the impact on timber plantings may have been felt shortly after passing of the legislation, the impact on timber harvests probably has not yet been felt as it takes anywhere from 20 to 80 years for a tree to reach the date at which profits are maximized by harvesting it.

Likewise, if stumpage profits were subjected to ordinary rates of income taxation rather than the preferential capital gains rates, the full impact of timber prices and supply would not be felt for many years. In analyzing the impacts it is useful to separate timber lands into two categories: those for which the growing of timber is the highest and best use under both systems of taxation, and those whose best use changes from timber to an alternative activity as income tax rates are increased. Only on the latter lands, which we will term marginal for timber supply, will taxation affect supply. On the marginal lands an

increase in tax rates will create incentives to liquidate timber holdings to facilitate the switch to alternative land uses. Thus, in the short run, timber supplies may be augmented by elimination of capital gains treatment of stumpage profits. In the long run, of course, supplies will be diminished as a consequence of the loss of output from the marginal lands.

If the long run supply of timber is indeed elastic, and if all of stumpage value is capital gain, the maximum long run impact of capital gains taxation on the price of stumpage would be 34.6 percent. (Under capital gains treatment, a unit of land, yielding timber worth $1.00 before taxes and $.70 after taxes, would have to yield $1.346 before taxes at the normal corporate rate of 48 percent to produce the same $.70 after taxes.) Historical transactions indicate that stumpage prices have averaged between 6 and 12 percent of market pulp prices.[6] This indicates that the maximum long run impact of capital gains taxation on market pulp prices would be 4.2 percent. (The 4.2 percent is obtained by multiplying 34.6 percent by 12 percent.)

Three factors indicate that 4.2 percent is an over-estimate of the impact of capital gains taxation on market pulp prices. First, it was assumed that there would be no substitution between factors in response to a change in the cost of one factor. The elimination of capital gains treatment for timber would raise the cost of capital and would be expected to induce some substitution of labor for capital. To an unknown degree this would reduce the impact of the elimination of the tax subsidy. Second, 100 percent of stumpage value is assumed to be capital gains income, even though some widely quoted sources have indicated a figure of 50 percent is more appropriate.[7] Third, the long run supply curve for stumpage was assumed to be infinitely elastic, yet one study located in the literature survey indicated that the best estimate of long run supply elasticity of Douglas-fir timber is only .1. If the more pessimistic assumptions are used the long run price impact could be as little as 0.1 percent, and the intermediate and short run impacts could well be nil.

B. Mining

The standard analysis of corporate taxation presented earlier in this chapter is not directly applicable to the mining industry. Unlike manufacturing new mining firms cannot obtain all inputs at constant cost. The supply of mineral deposits, in particular, is an increasing function of mineral prices. In addition, the owner of an operating mine must consider the impact of current production on the profits which could have been earned in later periods had production been delayed. In these respects, the standard analytical models of corporate taxation must be modified before they may be applied to the mineral industry. Existing work on theories of the mine and mining has assumed complete knowledge of the extent of ore reserves and the future course of taxation and mineral prices. The ability of such models to yield correct predictions to questions of taxation and the course of resource supplies over time is certainly open to question given the strong assumptions incorporated in model development. Nonetheless, we will briefly outline some of the existing theoretical models in the hope light will be shed on issues of interest to this report.

Hotelling's original work in the theory of exhaustion has been extended and generalized by **Schulze**[8] and **Peterson**[9] to allow for entry and exit of mining firms, externalities and taxation. In this section the notation will parallel that used by Schulze. It is assumed that all mineral deposits are known and are of uniform quality, and that mining firms operate in a world of perfect certainty. It is further assumed that mining firms are free to enter the industry and bid for the right to extract minerals from the known deposits. Firms may leave the industry at any time by selling their remaining rights to existing firms in the industry.

The notation to be used is as follows:

$q(t)$ = output of each firm (all are assumed identical at time, t)

$n(t)$ = number of firms

$p(nq)$ = price as a function of industry output

$B(nq)$ = benefits (willingness to pay for industry output)

$c(q)$ = long run cost function for firms

$\bar{X}$ = stock of the resource available for exploitation

r = social rate of discount (assumed equal to the competitive interest rate)

Pareto optimality is achieved by maximizing the present value of the net benefits for the entire industry,

$$\int_{t=0}^{\infty} \left[e^{-rt} B(nq) - nC(q) \right] dt$$

subject to the constraint on resource availability,

$$\int_{t=0}^{\infty} nq \, dt \leq \bar{X}.$$

This problem in the calculus of variations can be solved by introducing the Lagrange multiplier, λ, and maximizing

$$\int_{t=0}^{\infty} \left[e^{-rt} (B(nq) - nC(q)) - \lambda nq \right] dt$$

by using the Euler conditions to determine q(t), and a terminal condition to obtain the optimal period of extraction. The principal conclusions are twofold (the interested reader is referred to Schulze for the derivations):

1. price equals marginal cost plus an imputed cost of the resource expressable as the present value of foregone future profits;
2. the number of firms declines to zero as the terminal date of exhaustion is approached.

Hotelling was the first to demonstrate that a competitive extractive industry, wherein each firm attempted to maximize the present value of its profits, would satisfy the conditions for Pareto optimum. Of course, the presence of externalities, as would occur if benefits depended on the stock of resources left untouched by the extractive industry

as well as the cumulative output of the industry, would mean that the competitive extractive industry would no longer achieve the conditions of Pareto optimality. This problem, as well as the problem of recycling extracted resources, has been discussed by Schulze.

The models developed by Hotelling, Schulze, and Peterson do have implications for the impact of taxation on mineral industry supply curves. In general, they demonstrate that simple taxes and subsidies alter the optimal time path of production as well as being passed both forward into product prices and backward into land rents. Without a detailed specification of the availability of deposits of varying grades it would be impossible to predict tax incidence. Similarly, without complete knowledge of future mineral prices, the impact of taxation on intertemporal production paths is impossible to predict accurately. In the following individual industry analyses we assume the full magnitude of various taxes and subsidies are passed forward onto final product prices. Also, having . no real basis for predicting the impact of taxation on the time path of production, we chose to assume the net impact of uncertainty and all forms of taxation is neutral with respect to the timing of production.

1) Copper

Most United States primary copper is obtained through open pit mining of extensive porphyry copper deposits in the Western States. The copper content of ores presently mined averages between .6 percent and .9 percent copper, or some 12 to 18 pounds per.ton. Though most metals have fallen in real price over the last several decades, due primarily to rapid technological progress in mining and processing, the real price of copper has increased - a phenomenon that has been attributed to a persistent decline in the average grade of ore available for mining.

The cutoff grade is the designation of ore which contains just enough metal to permit further processing at a break even level of profitability. At the mine site copper ore is physically separated from waste

(ore below the cutoff grade) and shipped to concentrating plants. Beneficiation of copper generally includes crushing, grinding, classification, flotation, and filtration and results in copper concentrates containing 11 percent to 38 percent copper. Between 10 percent and 15 percent of domestic mine output of copper is obtained by leaching low grade waste material with a dilute solution of sulfuric acid. In several leaching operations large quantities of post-consumer steel cans are used as a source of iron to accelerate the process.

Iron and sulfur impurities in copper concentrates are removed through the separate processes of roasting, which is used to regulate the sulfur content; smelting, which eliminates most of the impurities and yields a product termed blister copper; and final purification through fire refining or electrolytic refining.

The significant tax provisions affecting the copper industry are percent depletion, expensing of exploration and development, the foreign tax credit, the investment tax credit, and severance taxes. These will be considered in turn.

Percent depletion is allowed on the value of copper concentrates at the rate of 15 percent for both domestic and foreign production. Copper concentrates are not traded on any established market and their value for tax purposes is obtained by allocating costs to other operations (especially smelting and refining) and treating the residual as the value of concentrates. The Bureau of Mines has estimated that smelting costs are about 4 cents per pound, refining costs about 6.4 cents per pound, and pollution control in smelting will add another 4 to 6 cents per pound to smelting costs in the future.[10]

Copper scrap substitutes for copper concentrates when the scrap contains significant impurities and requires smelting prior to refining. Often scrap copper, especially prompt industrial scrap, can be shipped directly

to refiners, and may be viewed as a substitute for blister copper. If blister copper is worth 20 percent more than copper concentrates and the full 15 percent is taken as percent depletion, the price of blister copper would be depressed by approximately (5/6) X .48 X .15 = 6%. At present, scrap copper competes with a virgin based product whose price may be lowered by at most 6 percent due to percent depletion.

In actual practice depletion is not always taken at the statutory 15 percent; the 50 percent of net income limitation, and cost depletion on certain properties reduce the actual rate of depletion. The Treasury Depletion Survey found actual depletion deductions in 1958, 1959, and 1960 were 11.7 percent, 12.8 percent, and 13.3 percent of gross income from copper concentrates.[11] Taking 13 percent as the average actual rate of percent depletion, the effect on price of blister copper is to reduce it by (5/6) X .48 X .13 = 5.0%.

Corporation 10-K Reports provide the basis for an alternative estimate of actual depletion experienced, and also provide more current information. Because depletion is reported only as the percentage reduction in effective tax rates (see Chapter 3), the actual amount of depletion must be calculated indirectly.

Let r = Reduction in effective tax rate attributable to depletion
t = Rate of corporate taxation (.48)
G = Income before income taxes
D = Amount of depletion

Then: $r = t - t(G-D)/G$, and depletion may be computed as;
$D = G(r/t)$.

The actual depletion rate experienced is given by D/M, where M is the value of mineral concentrates produced. Unfortunately it is necessary to estimate the value of mineral concentrates through an indirect process, because their value is not reported in 10-K reports. A rather laborious and probably error filled calculation for Kennecott Copper indicated

that depletion of $85 million was taken on mineral output worth some $740 million, for an estimated rate of depletion of 11.4 percent.

The impact of other taxes in mining is even more difficult to estimate. The previous discussion of expensing suggested that expensing of mineral exploration and development outlays in metal mining averaged about half of the deduction taken for depletion in excess of cost depletion. If it is assumed that recapture is postponed so far in the future that the present value of future tax liabilities is zero, the impact on market price would be about half that of depletion. Of course, if percent depletion were to be eliminated the mining firms would have some incentive to switch from expensing to cost depletion - thereby lessening the measured impact of expensing.

Earlier in this chapter the observation was made that the impacts of severance taxes are especially difficult to quantify. For those corporations itemizing all forms of taxation, severance taxes were about one-fifth of the depletion allowance.

The investment tax credit is one of the more significant tax subsidies available to industry, but because it is equally available to both primary and secondary producers, it would have an impact on relative prices in the two sectors only to the extent capital intensities differed.

The foreign tax credit and other special treatment of unremitted foreign income resulted in a reduction of 4 percent in the effective income tax rate for the Anaconda Company, but had no material impact on other domestic copper producers. Following nationalization of copper industry investments in Chile, the impact of the foreign tax credit upon the industry has been minimal.

2) Steel

The virgin raw materials used in steel production are iron ore, coal, and limestone. The intermediate product pig iron competes directly with scrap steel as the charge to the basic oxygen and open hearth furnaces. The basic oxygen furnace, which produces about 56 percent of domestic steel output, can accept charges of varying proportions, the upper limits on scrap now being over 40 percent if the scrap charge is preheated. The open hearth furnace, which is declining in importance and accounts for approximately 25 percent of domestic steel output, accepts a charge of both scrap and virgin product with no restrictions on input proportions. In electric furnaces pre-reduced iron ore is a technological substitute for scrap steel as an input, though relative input prices normally favor the use of scrap.

The principal tax preferences obtained by the producers of virgin inputs to pig iron production are depletion allowances on all three inputs, and capital gains which are allowed, but not widely utilized, on the production of iron and coal. The tax code permits depletion of 15 percent on iron ore, 10 percent on coal, and 14 percent on limestone. Prediction of the impact of tax preferences for the production of inputs to the steel making process will require knowledge of the stage of production at which the tax benefits may be taken. Depletion on coal is taken after mining and washing - essentially the final output stage. Percentage depletion on iron ore is taken at the concentration stage and on limestone it is taken at the crushing stage - both of which are also essentially final outputs.

The analysis of the impact of preferential taxation on primary extractive industries on material recycling must consider tax induced changes in relative prices at the point where scrap competes with the equivalent virgin input. In steel production the relevant virgin input is pig iron, but the calculation of the impact of taxation on its price is subject to unusually large margins of error. First of all the quoted

market price of pig iron is unreliable since less than 10 percent of pig iron production is bought and sold on domestic markets. Pig iron production is dominated by a few firms and their reaction to changes in input prices is difficult to predict. Finally the technical possibilities for capital labor substitution in response to a change in relative factor prices are assumed (but not necessarily known) to be minimal.

Pig iron can be produced with some variation in inputs - especially in the amounts of coke and limestone which are used. According to Vaughan[12], the recent experience of the steel industry has been to use approximately 3,000 pounds of iron ore, 1,000 pounds of coke, and 400 pounds of limestone to produce a ton of pig iron. These proportions vary somewhat depending on the metal content of the iron ore, as well as on the coke and limestone proportion. The maximum impact of depletion allowances on the price of pig iron is obtained when all inputs are elastically supplied.

Table 6-4. DEPLETION ALLOWANCES IN PIG IRON COSTS

Input.	Input per ton of pig (in tons)	Rate of Depletion	Input Price (May 1974) At stage where Depletion is taken	Net Savings in taxes
Metallurgical Coal	.77	10%	$30 per ton	$1.11
Limestone	.2	14%	$ 2 per ton	$ .03
Iron Ore	1.5	15%	$11 per ton	$1.19

Table 6-4 summarizes the maximum effect mineral depletion have on the price of pig iron. At a current market price of $77 per ton, the $2.33 attributable to depletion amounts to 3.0 percent of product price. The impact of percent depletion will be reduced to the extent cost depletion is used, to the extent the 50 percent of net income limitation applies, and to the extent supplies of the virgin materials are less than infinitely elastic. The combined effect of the separate limiting influences can be significant. For Pittston and Westmoreland Coal mineral depletion deductions ranged

between 2.19 percent and 3.51 percent of final product price in 1973 and 1974, far less than the statutory 10 percent used in computations here.[13]

The Treasury Depletion Survey of 1958-1960 provides additional information on depletion rates actually realized. Table 6-5 reports depletion as a percent of gross income for the suppliers of primary inputs to pig iron production. Both cost depletion and the 50 percent of net income limitation act as constraints on depletion actually achieved.

Table 6-5. DEPLETION AS PERCENT OF GROSS INCOME

	Statutory rate	1958	1959	1960
Iron	15%	13.5%	13.4%	14.0%
Anthracite	10%	5.7%	3.6%	2.7%
Limestone	14%	12.4%	13.3%	13.2%

Source: President's 1963 Tax Message

State severance taxes may, to a considerable degree, counteract the favorable impacts of percent depletion on these extractive industries. The 15 1/2 percent Minnesota severance tax.on iron ore and the 15 percent tax on taconites appear to more than offset the subsidy of percent depletion at 15 percent. (Recall that $d = s(t-1)/t$, so that for a tax rate of 48 percent a severance tax of 15 percent is exactly balanced by depletion at the rate of 16.25 percent.) Kentucky's coal severance tax of 4 percent approximately counters the depletion earned on coal (at least that mined in Kentucky).

Another special form of tax preference for coal and iron ore production is the capital gains provision on royalties. Section 631 of the Internal Revenue Code specifies that, for those producers using cost depletion to recover capital costs, the difference between the amount realized from the sale of any coal or iron ore from a property and the adjusted basis for that production is considered a capital gain, providing the property

was held for at least six months prior to the production of the minerals. In actual practice, deductions for capital gains in iron and coal production are rarely taken (they amount to a savings in income taxes of about $5 million per year), primarily because most producers find percent depletion permits a greater deduction against tax liability than does cost depletion, even when the latter is coupled with a provision for capital gains.

3) Aluminum

Aluminum is manufactured by processing alumina (aluminum oxide) bearing ores such as bauxite to obtain alumina, and then electrolytically reducing alumina in a molten bath of cryolite into aluminum ingot. Percent depletion is allowed at a rate of 22 percent for domestic bauxite production and 14 percent for foreign production. Bauxite costs prior to the formation of the International Bauxite Association (IBA) in 1974 have been placed at about 10 percent of ingot costs.[14] Bauxite taxes in the amount of about 6 percent of ingot price were recently imposed by IBA and could, if allowed by the Internal Revenue Service, serve to increase the base on which depletion deductions may be taken by over 60 percent.

Domestic bauxite production accounts for about 10 percent of consumption, and the remainder is imported from various foreign sources. Although Jamaican bauxite deposits have approximately the same 50 percent alumina content as domestic sources, they enjoy significant advantages in terms of accessibility and silica content. Other important foreign bauxite sources are generally less competitive. Guyana's ore, though richer in alumina content at a 57 percent concentration, is covered with a heavy overburden, and Australian ore must be transported greater distances.

One significant area of competition between virgin and secondary aluminum supplies is as an input to the castings industry where scrap competes directly with primary aluminum ingot. Historically scrap, as secondary aluminum ingot, has been the dominant input, but proportions have varied depending

on scrap availability and shipments by the castings industry. Another area of competition is between primary and secondary extrusion ingot which is shipped to independent fabricators. Because of input substitution at the ingot level, the impact of depletion deductions will be computed for primary aluminum ingot.

The maximum impact of percentage depletion on the price of aluminum ingot would be obtained if:

(1) Depletion is allowed on the value of bauxite including the foreign taxes (making bauxite 16 percent of ingot value).
(2) Primary ingot supply is infinitely elastic in the long run.
(3) Bauxite deposits are sufficiently profitable so that the 50 percent of net income limitation on depletion deductions does not apply.

On foreign sources of bauxite depletion could account for at most .16 x .14 = 2.2% of ingot price, whereas on domestic bauxite supplies depletion could account for somewhat more. Domestic bauxite prices and quantities used for the production of aluminum indicate bauxite could have accounted for 11 percent to 12 percent of ingot value in 1971. (Four tons of bauxite valued at $14 per ton were used to produce every ton of primary ingot worth $580 per ton.) Assuming bauxite now accounts for 18 percent of ingot value, depletion could amount to .22 X .18 = 4.0% of ingot value.

The actual experience in the aluminum industry in 1973 was as follows: Alcoa produced 1,625,000 tons worth $812.5 million and obtained percentage depletion of $11.6 million of 1.4 percent; Kaiser Aluminum and Chemical produced 847,261 tons worth $395 million and obtained percentage depletion of $7.5 million of 1.9 percent; and Reynolds Aluminum produced 464,368 tons worth $232.8 million and obtained percentage depletion of $5.3 million of 2.3 percent.[13, 15] Since Reynolds Aluminum controls most of the domestic production of bauxite, it is to be expected that depletion would be more important to Reynolds Aluminum as a percentage of final product price

than it is for the other producers.

The impact of percent depletion in terms of lower prices for final outputs is, at most, equal to the tax savings, or 48 percent of the ratio of depletion to final product price. Percent depletion would thus reduce market price by somewhere between .7 and 1.9 percent.

4) Lead

The most common lead minerals include galena (lead sulfide), cerussite (lead carbonate), and angesite (lead sulfate).[16] Galena, the most abundant source of commercially mined lead, is often found mixed with traces of zinc, silver, and gold. Galena ores in Missouri, which are the source of over 70 percent of domestic production, are essentially free of trace metal contamination. Lead ores are normally milled at the mine site, and the lead is physically separated from other valuable ore constituents through differential flotation. Lead concentrates obtained from milling are then smelted in blast furnaces or open hearths to burn off the sulfur and reduce lead oxides to metallic lead. Lead bullion from smelters in Missouri is pure enough for most applications, but western and most foreign ores contain base metal impurities which must be removed through refining before the lead is sufficiently pure for many commercial uses. The gold content of western and foreign ores normally makes separate extraction of gold profitable.

Percentage depletion for primary production is allowed at the rate‘of 22 percent for domestic ores and 14 percent for foreign ores. Depletion is taken on the value of lead concentrates, a commodity which normally is not traded and for which representative prices are not published. The Internal Revenue Service uses a method called "proportionate profits" to allocate costs at various stages to the value of final output. For each producer apparent costs of mining, concentrating, smelting, and refining are computed and any residual profit is allocated among the various operations. Depletion is then taken on the estimated value added through processing to lead concentrates. The actual imputed value of lead concentrates for each producer will vary depending on the efficiency of the operation and the lead content

of the ore being mined. The identical problem of imputing values to intermediate products which do not have readily defined market prices is encountered for other minerals such as copper.

Statistics on the value of lead concentrates were obtained indirectly from a recent Commerce Department publication.[17] In 1972 mine output of 900,000 tons of lead concentrates was valued at $137,300,000, indicating an average value of about 7.6 cents per pound. This compares with an average price of 15 cents per pound for refined lead for that year.

Lead recovered from scrap materials has exceeded domestic primary metal production since 1958 and is, therefore, of considerable importance in the domestic supply pattern. Secondary refined lead is indistinguishable from primary refined lead and substitution takes place freely. For most uses lead bullion from primary and secondary smelters also substitutes freely. Estimation of the impact of tax preferences on recycling will be based on a market model for metallic lead with a single demand curve and a supply curve composed of the summation of supplies from primary and secondary sources.

Computation of the actual tax savings derived from percentage depletion once again is complicated by the restriction that depletion not exceed 50 percent of net income from mining. Profit rates for the mining and concentrating facilities of major producers are unknown - here it is assumed profits are sufficiently large to permit the maximum possible deduction for mineral depletion. The primary lead supply curve would be shifted upward by at most .48 X .22 X 7.6/15 = 5.3% should the depletion allowance on lead be eliminated. Again the Treasury Depletion Survey enables one to compare realized depletion rates with the maximum permitted by law.[11] For lead and zinc (the two were grouped together) depletion as a percent of gross revenues from lead concentrates ranged from 9.5 percent to 11.4 percent, or far below the 23 percent permitted at that time. The primary reasons depletion deductions were so low is that the cost depletion method

of recovering exploration and development outlays was more beneficial. Assuming the same pattern holds today, percent depletion may depress the price of primary lead from 2.5 percent to 3 percent.

5) Short Run Supply Curves

A significant portion of the estimated tax induced shift in final output price depends upon the existence of an elastic long run mineral supply curve. That supply may be less than elastic in the short run, due primarily to capacity constraints, undoubtedly holds for most if not all of the minerals discussed here. Though an apparently common phenomenon to mineral engineers, a backward bending short to medium run supply curve for mineral output is, to economists, an unexpected consequence of limitations in milling capacity.

Because cost of transporting mineral ores for processing would quickly absorb the entire value of mine output, ore concentration or beneficiation facilities, which mill and physically separate metallic constituents through differential flotation, are normally located at the mine site. Milling capacity at the mine effectively limits the rate at which ore can be processed in the short run.

Economists have demonstrated that, at least in theory, the present value of a mine is maximized by mining the highest grade ores initially and reserving lower grade ores for the future. Therefore an increase in the demand for final smelter or refining outputs resulting in higher metal prices should have no effect on the grade of ore presently mined. Indicative of the failure of the theoretical models to reflect actual mining decisions is this revealing quotation from Homestake Mining's 1973 annual report:

> "As the year progressed and the gold price rose, daily tonnage at the mine increased first by mining to a lower cutoff grade in all the active stopes and later by initiating production from blast hole stopes containing ore previously too low in grade to be profitably mined."

Extraction of low grade ores encountered in normal mining operations, which would be bypassed and perhaps irretrievably buried when metal prices are depressed, is profitable and extends the life of the mine when metal prices are high. Though a rigorous demonstration is difficult to formulate, mining of lower grade ores at certain locations during periods of elevated metal prices could well increase the present value of the mine.

The hypothesis that short to medium run supply curves are backward bending is further supported by actual production statistics for major western gold producers in recent years. For Homestake and Sigma production dropped significantly in 1973 despite a 68 percent increase in the average price during the year, while at Dome and Campbell Red Lake output was approximately unchanged. The average grade of ore mined by Homestake fell from .285 oz. per ton in 1971 to .278 oz. in 1972 and .227 oz. in 1973. For the other three producers the average grade mined also declined as the price of gold advanced.

Table 6-6. GOLD PRODUCTION AND MILLING STATISTICS

	1973	1972	1971
Average Price Received	$95	$56.50	$43
Homestake Mining	357,634 oz 1,575,000 tons	407,462 oz 1,466,000 tons	513,374 oz 1,801,000 tons
Dome Mines Ltd.	148,500 oz 682,000 tons	146,000 oz 630,000 tons	
Campbell Red Lake	196,000 oz 304,000 tons	197,000 oz 303,000 tons	
Sigma Mines	78,000 oz 521,000 tons	86,000 oz 521,000 tons	

Source: Corporation 10-K Reports

Should short to medium run primary metal supply curves be backward bending the assumed connection between elimination of the mineral depletion allowance (or other tax subsidies) and higher virgin metal prices would have to be reexamined. Without the depletion allowance the short run response of mining firms should be to increase the cutoff grade below which ore will not be removed. Given a desire to maximize the present value of the mine, the mine owners could well continue mining at a rate which would fully utilize existing milling capacity as long as receipts covered variable costs. Although ore removals and quantities milled might remain constant, the output of metal would rise as higher grade ores were mined. All of this indicates that the short run response to the elimination of the mineral depletion allowance, could, depending upon the mineral and opportunities to upgrade the grade of ore being mined, result in an increase in virgin metal supplies and a concomitant decrease in metal prices.

CHAPTER 6

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